

PBEEEP

State Government

Public Buildings Enhanced Energy Efficiency Program

Final Report Investigation Results For Department of Transportation Building



Date: 5/10/2012



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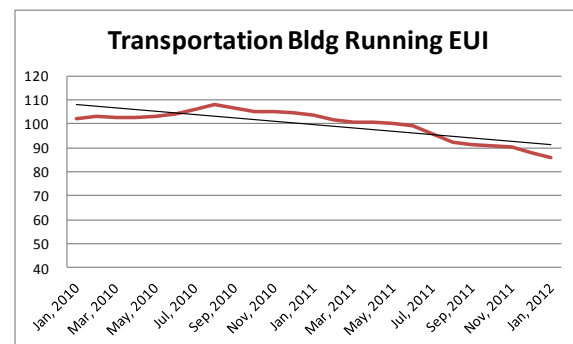
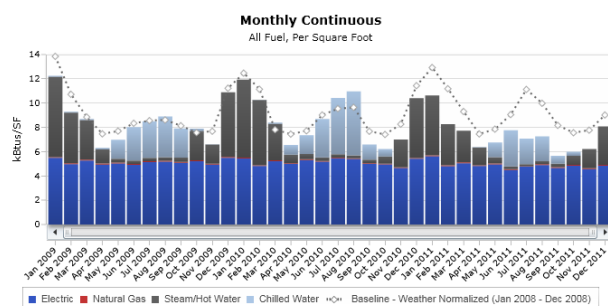
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Department of Transportation Building Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Department of Transportation Building was performed by Sebesta Blomberg, Inc. This report is the result of that information.

Payback Information and Energy Savings					
Total project costs (Without Co-funding)			Project costs with Co-funding		
Total costs to date including study	\$84,007		Total Project Cost	\$930,128	
Future costs including Implementation , Measurement & Verification	\$846,121		Study and Administrative Cost Paid with ARRA Funds	(\$87,007)	
Total Project Cost	\$930,128		Utility Co-funding	\$25,000	
			Total costs after co-funding	\$818,121	
Estimated Annual Total Savings (\$)	\$96,002		Estimated Annual Total Savings (\$)	\$96,002	
Total Project Payback	9.7		Total Project Payback with co-funding	8.5	
Electric Energy Savings (498,399 of 6,401,751 kWh (2011))			District Energy Savings (3,300 of 11,035 MMBTU (2011))		
7.8%			and 29.9 %		



Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost \$	Average Cost Rate \$ /kBtu
2009	365	374,818	38,320,412	40,747,561	-2,427,149	-6%	\$757,937.74	\$0.02
2010	365	374,818	39,276,256	41,081,006	-1,804,751	-4%	\$765,959.28	\$0.02
2011	365	374,818	32,909,912	41,764,096	-8,854,185	-21%	\$731,757.13	\$0.02

Department of Transportation Building Consumption Report
Total energy use decreased 15% during the period of the investigation



STATE OF MINNESOTA B3 BENCHMARKING

Summary Tables

Department of Transportation Building	
Location	395 John Ireland Blvd, St Paul, MN 55155
Facility Manager	Gene Peterman
Interior Square Footage	374,818
PBEEEP Provider	Sebesta Blomberg, Inc.
State's Project Manager	Harvey Jaeger
Annual Energy Cost	\$ 731,757 (2011) Source: B3
Utility Company	Xcel Energy (Electric) St Paul District Energy (Steam & Chilled Water)
Site Energy Use Index (EUI)	102 kBtu/ft ² (at start of study) 86 kBtu/ft ² (at end of study)
Benchmark EUI (from B3)	110 kBtu/ft ²

Building Name	State ID	Square Footage	Year Built
Department of Transportation Building	G0231010562	374,818	1956

	Mechanical Equipment Summary Table (of buildings included in the investigation)
Quantity	Equipment Description
1	Honeywell EBI Automation System
1	Building
374,818	Interior Square Feet (before 1,200 sqft addition)
8	Air Handlers
~430	VAV Boxes
1	Make-up Air Unit
9	Computer Room Air Conditioning Units
1	Steam Boiler (electric)
8	Pumps (HW and CHW)
250	Approximate number of points for trending

Implementation Information			
Estimated Annual Total Savings (\$)			\$96,002
Total Estimated Implementation Cost (\$)			\$843,121
GHG Avoided in U.S Tons (CO2e)			664
Electric Energy Savings (kWh) 7.8 % Savings 2011 Electric Usage 6,401,751 kWh (from B3)			498,399
Electric Demand Savings (Peak kW)			139
District Hot Water Savings (MMBtu) 38% Savings 2011 Usage 7,256 MMBtu from B3			2,774
District Chilled Water Savings (MMBtu) 15 % Savings 2011 Usage 3,509 MMBtu from B3			526
Statistics			
Number of Measures identified			8
Number of Measures with payback < 3 years			5
Screening Start Date	11/8/2010	Screening End Date	12/3/2010
Investigation Start Date	1/21/2011	Investigation End Date	4/23/2012
Final Report	5/10//2012		

Department of Transportation Building Cost Information		
Phase	To date	Estimated
Screening	\$3,588	
Investigation [Provider]	\$64,000	
Investigation [CEE]	\$16,419	\$1,000
Implementation		\$843,121
Implementation [CEE]		\$1,000
Measurement & Verification	0	\$1,000
Total	\$84,007	\$846,121

Co-funding Summary	
Study and Administrative Cost	\$87,007
Utility Co-Funding - Estimated Total (\$)	\$25,000
Total Co-funding (\$)	\$112,007

Facility Overview

The energy investigation identified 15.2% of total energy savings at Department of Transportation Building with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Department of Transportation Building are based on adjusting the schedule of equipment to match actual building occupancy hours primarily in places where night set back is not used, replacing sensors that have failed and completing the conversion of pneumatic to digital control of VAV boxes. The total cost of implementing all the measures is \$843,121. The conversion to DDC accounts for \$749,621 of this cost, and also for 51% of the projected savings.

Implementing all these measures can save the facility approximately \$96,000 a year with a combined payback period of 8.8 years before rebates based on the implementation cost only (excluding study and administrative costs). These measures will produce 7.8 % electrical savings and 38 % hot water savings and 15 % chilled water savings. The building is currently performing at 22% below the Minnesota Benchmarking and Beyond database (B3) benchmark; energy usage during the period of the study declined by 15%.

The primary energy intensive systems at Department of Transportation Building are described here:

The Department of Transportation Building is a 374,818 square foot (sqft) building located in St. Paul, MN. The building primarily consists of office space, but there is also a cafeteria (9,905 sqft), a computer center (4,289 sqft), and an underground parking garage (12,686 sqft). It has a tower on the Northern end of the building that is nine stories above grade (ground floor through eighth floor) and two stories below grade (basement and sub-basement). The Southern part of the building (approximately half the building footprint) has two stories above grade.

Mechanical Equipment

The building is conditioned by hot and chilled water from St. Paul District Energy. The hot water is available year-round and the chilled water is available from April 1st to November 1st each year. District hot water is brought into the sub-basement of the building where it is then run through heat exchangers. There is one heat exchanger that transfers the heat from the district hot water to glycol. The glycol is circulated to a make-up air unit and four of the air handlers. There are two other heat exchangers that transfer heat from the district hot water to hot water loops that serve two air handlers, VAV boxes, unit heaters, and finned-tube radiation. The district chilled water is also brought into the sub-basement, but there are no heat exchangers in the chilled water loop. The district chilled water is pumped directly to the air handlers to provide cooling.

There are two large air handlers (AHU 2 and 3) in the sub-basement that serve the basement through sixth floor of the tower portion of the building. The air handlers serve VAV boxes in the spaces. Two air handlers (S 7 and S 8) serve VAV boxes in floors seven and eight of the tower. There are four smaller air handlers (AHU 1, 4, 7, and 10) that serve the sub-basement, elevator equipment room, mail room, and the portion of the ground and first floors that are not part of the tower. There is also a make-up air unit that serves the garage.

The air handlers along with some other mechanical equipment were replaced in phases, beginning in 1991 and ending in 2001. The building originally had perimeter radiation, but almost all of it was removed during the phased equipment replacements. The only remaining hot water perimeter radiation is in the

cafeteria along the exterior windows. The VAV boxes were not replaced during the air handler replacements and the age of the VAV boxes is unknown; however, there are reported to be plans to replace the VAV boxes when funding becomes available, but this has not been confirmed.

The two large air handlers, AHU 2 and 3, serve the North and South sides of the tower from the basement to the sixth floor. Since the time that these air handlers were installed in 1997, they have had problems reaching the duct static setpoint even when the VFDs are at 100% speed. A balancing report was done on the air handlers in 2000 and it confirmed that they were not able to achieve a high enough duct static to supply the VAV boxes with adequate supply air.

Controls and Trending

The building runs on a Honeywell EBI R310.1 Building Automation System (BAS), which is part of the State Capitol Complex system. The Plant Management Division (PMD) of the Department of Administration controls the BAS.

Lighting

A lighting upgrade project is in progress and not covered in this report.

Metering

The building has one electric meter, one natural gas meter, one chilled water meter, and one hot water meter. Natural gas is used only by the kitchen.



Findings Summary

Site: Transportation Building

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
14	Transportation Building	All AHU heating valves are open when units are off.	\$1,980	\$2,763	0.72	\$0	0.72	14
32	Transportation Building	AHU Scheduling Combined	\$15,730	\$21,009	0.75	\$0	0.75	110
31	Transportation Building	AHU-2 return section has significant gaps.	\$2,200	\$1,435	1.53	\$0	1.53	6
13	Transportation Building	MAU-1 CO monitor readings inaccurate.	\$21,230	\$9,691	2.19	\$0	2.19	43
15	Transportation Building	MAU-1 space temperature maintained above setpoint	\$3,520	\$1,265	2.78	\$0	2.78	4
33	Transportation Building	AHU OA Control Combined	\$41,800	\$10,762	3.88	\$0	3.88	39
6	Transportation Building	AHU-2 Supply duct static pressure sensor not working correctly.	\$7,040	\$1,544	4.56	\$0	4.56	16
24	Transportation Building	DDC VAV upgrade and space setpoint measures combined for AHUs 1,2,3,7, and 8	\$749,621	\$47,534	15.77	\$0	15.77	431
		Total for Findings with Payback 3 years or less:	\$44,660	\$36,162	1.23	\$0	1.23	178
		Total for all Findings:	\$843,121	\$96,002	8.78	\$0	8.78	664

Investigation Checklist



Rev. 2.0 (12/16/2010)

14201 - Transportation

This checklist is designed to be a resource and reference for Providers and PBEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	Pneumatic VAV reheat valves are "enabled" 24/7. AHU S-7 is operated until 1am for an occupancy of less than 5 people	Entire building		Due the nature of the pneumatic control for the VAVs there is not an unoccupied mode for the VAVs to control to. During unoccupied hours the re-heat valves and dampers continue to operate without airflow from the AHUs.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	24/7 during coldest BIN hours. FWB #3, 5, 16, 23	All HVAC equipment.		Trending indicates all HVAC equipment operates 24/7 during coldest BIN hours. (0 deg F and lower)
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	Data loggers with light meters verify light lights are typically on only during normal occupied hours.
	a.4 (4)	OTHER Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	FWB # 4, 8, 10, 19, 20, 23 Failed VAVs are causing AHUs 2 and 3 to require additional ventilation because the RF cannot return enough air. S-7 OA damper, AHU-1 Damper	AHU-2 and AHU-3		Analysis of AHU-2/3 and associated VAV performance revealed that the failed VAVs cause the AHU to operate at full capacity. In this scenario the return fans cannot bring enough air back to the AHU for supply so OA is used as make-up. Both AHU-1 and S-7 units OA dampers are not in good functioning order (stick in some positions and do not close fully).
	b.3 (7)	OTHER Economizer/OA Loads	FWB # 22 Dampers do not fully close.	AHU-2 and S-7		
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	Heating water use is discontinued above 55 deg F.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	VAV thermostat locations not ideal			Due to the open office type construction of the building the thermostats are located on structural columns closest to the VAV zone. Many enclosed office spaces are controlled by a T-Stat which is in a location outside of the office.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints				Investigating
	c.4 (11)	OTHER Controls	FWB # 4, 8, 10, 19, 20 AHU supply Differential Pressure Sensors Failed			Due to age and condition all AHU sensors are in question.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	Building does not utilize these devices
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	FWB # 21 Temperature setpoint is 72F all year			Stats are local control only and require building staff to change seasonally if different setpoints for heating and cooling are used. Space occupant in some locations is able to change the setpoint at any time.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	FWB # 4, 8, 10, 19, 20 Fan speeds are excessive for time of year	AHU-1,2,3 and S-7,8		Trending and AHU assessments revealed that fan speeds are much higher than expected for the season and in most cases do not vary in speed by more than 10%.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently				
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	FWB # 4, 8, 10, 19, 20 VAV testing found box flow rates are higher than the original design	AHU-1,2,3 and S-7,8		VAV sampling and test results indicate the Pneumatic controls are out of calibration/failing and require replacement and rebalancing of local diffusers to return system to design levels
	d.6 (17)	Other Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal				
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal				
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	Discharge air temperature is too high during the cooling season	AHU-1,2,3 and S-7,8		The AHUs are designed to provide a discharge air temperature of 55°F and they are actually supplying 63-65°F. This high discharge air temperature requires much higher supply air volume to satisfy the space cooling needs.

Investigation Checklist



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Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
	e.4 ()	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Not Relevant	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled				
	f.3 (25)	Over-Pumping	FWB # 14 Heating valves positions are set to 50% open for freeze protection at night			Heating water pumps operate at higher speeds during unoccupied times.
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER Equipment Efficiency/Load Reduction	Fan motors			
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans	Need to replace some VFD S-7 and 8 Relief fans			Units S-7 and S-8 relief fan VFDs are in need of replacement
	g.2 (29)	VFD Retrofit - Pumps			Investigation looked for, but did not find this issue.	
	g.3 (30)	VFD Retrofit - Motors (process)			Investigation looked for, but did not find this issue.	
	g.4 (31)	OTHER VFD			Investigation looked for, but did not find this issue.	
h. Retrofits:	h.1 (32)	Retrofit - Motors	Some motors to be replaced in FWB#3	MAU-1 and garage EF		
	h.2 (33)	Retrofit - Chillers			Not Relevant	District Chilled Water
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Investigation looked for, but did not find this issue.	
	h.4 (35)	Retrofit - Boilers			Not Relevant	District Hot Water
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	NA
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	NA
	h.7 (38)	Retrofit - Equipment (custom)			Investigation looked for, but did not find this issue.	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	Piping strategy for basement heat exchangers is not ideal but is functioning well enough that an upgrade for energy savings will not have a good payback. This
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Investigation looked for, but did not find this issue.	We reviewed the previous lighting study and found no additional measures. Also, most of the lighting retrofits are either complete or in process.
	h.12 (43)	Retrofit - Building Envelope			Investigation looked for, but did not find this issue.	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER Retrofit			Not Relevant	
	i.1 (46)	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	

Investigation Checklist



Rev. 2.0 (12/16/2010)

14201 - Transportation

This checklist is designed to be a resource and reference for Providers and PBEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
i. Maintenance Related Problems:	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ()	Leaky/Stuck Damper	OA dampers stick/leak	AHU-1 and S-7	Not Relevant	No longer relevant. These dampers have been replaced recently.
	i.4 ()	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER Maintenance			Investigation looked for, but did not find this issue.	
j. OTHER	j.1 (49)	OTHER			Investigation looked for, but did not find this issue.	

Findings Glossary: Findings Examples

a.1 (1)	Time of Day enabling is excessive
	<ul style="list-style-type: none"> • HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive
	<ul style="list-style-type: none"> • Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	Lighting is on more hours than necessary
	<ul style="list-style-type: none"> • Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	OTHER Equipment Scheduling and Enabling
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
b.1 (5)	Economizer Operation – Inadequate Free Cooling
	<ul style="list-style-type: none"> • Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	Over-Ventilation
	<ul style="list-style-type: none"> • Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	OTHER Economizer/Outside Air Loads
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
c.1 (8)	Simultaneous Heating and Cooling is present and excessive
	<ul style="list-style-type: none"> • For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement
	<ul style="list-style-type: none"> • OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints
	<ul style="list-style-type: none"> • CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	OTHER Controls
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
d.1 (12)	Daylighting controls or occupancy sensors need optimization
	<ul style="list-style-type: none"> • Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	Zone setpoint setup / setback are not implemented or are sub-optimal
	<ul style="list-style-type: none"> • The cooling setpoint is 74 °F 24 hours per day
d.3 (14)	Fan Speed Doesn't Vary Sufficiently
	<ul style="list-style-type: none"> • Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	Pump Speed Doesn't Vary Sufficiently
	<ul style="list-style-type: none"> • Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary
	<ul style="list-style-type: none"> • Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	Other Controls (Setpoint Changes)
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal
	<ul style="list-style-type: none"> • HW supply temperature is a constant 180 °F. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal
	<ul style="list-style-type: none"> • CHW supply temperature is a constant 42 °F. It could be reset, based on demand or ambient temperature.
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal
	<ul style="list-style-type: none"> • The SAT is constant at 55 °F. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ()	Supply Duct Static Pressure Reset is not implemented or is suboptimal
	<ul style="list-style-type: none"> • The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal
	<ul style="list-style-type: none"> • CW temperature is constant leaving the tower at 85 °F. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	Other Controls (Reset Schedules)
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
f.1 (23)	Lighting system needs optimization - Spaces are overlit
	<ul style="list-style-type: none"> • Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	Pump Discharge Throttled
	<ul style="list-style-type: none"> • The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	Over-Pumping
	<ul style="list-style-type: none"> • Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	Equipment is oversized for load
	<ul style="list-style-type: none"> • The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	OTHER Equipment Efficiency/Load Reduction
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
g.1 (28)	VFD Retrofit Fans
	<ul style="list-style-type: none"> • Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	VFD Retrofit - Pumps
	<ul style="list-style-type: none"> • 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	VFD Retrofit - Motors (process)
	<ul style="list-style-type: none"> • Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	OTHER VFD
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
h.1 (32)	Retrofit - Motors
	<ul style="list-style-type: none"> • Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	Retrofit - Chillers
	<ul style="list-style-type: none"> • Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)
	<ul style="list-style-type: none"> • Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	Retrofit - Boilers
	<ul style="list-style-type: none"> • Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	Retrofit - Packaged Gas-fired heating
	<ul style="list-style-type: none"> • Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	Retrofit - Heat Pumps
	<ul style="list-style-type: none"> • Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	Retrofit - Equipment (custom)
	<ul style="list-style-type: none"> • Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	Retrofit - Pumping distribution method
	<ul style="list-style-type: none"> • Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	Retrofit - Energy / Heat Recovery
	<ul style="list-style-type: none"> • Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	Retrofit - System (custom)
	<ul style="list-style-type: none"> • Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	Retrofit - Efficient lighting
	<ul style="list-style-type: none"> • Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	Retrofit - Building Envelope
	<ul style="list-style-type: none"> • Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	Retrofit - Alternative Energy
	<ul style="list-style-type: none"> • Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	OTHER Retrofit
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
i.1 (46)	Differed Maintenance from Recommended/Standard
	<ul style="list-style-type: none"> • Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	Impurity/Contamination
	<ul style="list-style-type: none"> • Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ()	Leaky/Stuck Damper
	<ul style="list-style-type: none"> • The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ()	Leaky/Stuck Valve
	<ul style="list-style-type: none"> • The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	OTHER Maintenance
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
j.1 (49)	OTHER
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval

Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	6
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-2 Supply duct static pressure sensor not working correctly.	Date Identified:	3/4/2011
Description of Finding:	Trending data shows a supply static of 0.85" when the supply and return fans are off.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls Problems
Finding Type:	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement		

Implementer:	Contractor	Benefits:	Improved VFD control resulting in energy savings.
Baseline Documentation Method:	Trending of static pressure at times when the fans were ON vs. OFF		
Measure:	Replace duct static pressure sensor		
Recommendation for Implementation:	Solicit a controls contractor to remove and replace existing differential pressure sensor with a new sensor. Verify correct installation location based on sensor's manufacture recommendations. Contractor is to calibrate sensor. This measure should be implemented at the same time as Finding #8 to achieve maximum savings in that measure.		
Evidence of Implementation Method:	Trending and functional testing. Trend differential pressure sensor and fan VFD speed. Trending to occur for 3 weeks during any season. Trend interval to be 15 min or less. Verify differential pressure is maintained while VFD modulates based on demand. Functional test unit by adjusting differential setpoint and verify VFD modulation to maintain setpoint.		

Annual Electric Savings (kWh):	16,162	Peak Demand Savings (kWh):	10
Estimated Annual kWh Savings (\$):	\$1,157	Estimated Annual Demand Savings (\$):	\$0
Annual District Energy-Chilled Water Savings (kBtu):	27,019	Annual District Energy-Hot Water Savings (Gallons):	5,562
Est Annual District Energy-Chilled Water Savings (\$):	\$270	Est Annual District Energy-Hot Water Savings (\$):	\$117
Contractor Cost (\$):	\$4,664		
PBEEP Provider Cost for Implementation Assistance (\$):	\$2,376		
Total Estimated Implementation Cost (\$):	\$7,040		

Estimated Annual Total Savings (\$):	\$1,544	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	4.56	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	4.56	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	16	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.6%	Percent of Implementation Costs:	0.8%

Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	13
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	MAU-1 CO monitor readings inaccurate.	Date Identified:	3/14/2011
Description of Finding:	Trending of the CO monitor indicates that the sensor is out of calibration. CO readings in the trends range from 20-40 ppm throughout the duration of trending. A CO data logger placed in the same space logged from 0 ppm most hours to spike around 15-30 ppm.		
Equipment or System(s):	AHU with heating only	Finding Category:	Controls Problems
Finding Type:	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement		

Implementer:	Contractor	Benefits:	Energy savings due to reduced fan speeds during occupied hours.
Baseline Documentation Method:	EBI trends compared to CO data logger		
Measure:	Install ToxAlert system to control activation of MAU		
Recommendation for Implementation:	Solicit a contractor to install a ToxAlert system which utilizes 3 CO monitors and controls the activation of the MAU and associated exhaust fans. This also includes the installation of new premium efficiency fan motors and VFDs. ASHRAE 62.1 states auto repair shops are required to have a minimum exhaust rate of 1.5 CFM/sq ft. The MAU shall provide 5000CFM of supply air and the minimum fan speed shall be set to 20 Hz. The Exhaust fan shall be set to 7000CFM of exhaust and the minimum fan speed shall be set to 25 Hz. The ToxAlert system shall be programmed to maintain the minimum exhaust rate until CO levels rise above a specified limit. At that point the system will operate at full speed until the CO level is below setpoint.		
Evidence of Implementation Method:	Trending of CO sensor and outside air damper, return air temperature, mixed air temperature, outside air temperature, and the supply fan status/VFD speed. Trending shall occur during the season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO sensor using a know concentration of CO test gas to verify sensor reading. Also, test CO override when levels rise above setpoint. When CO setpoint is exceeded the unit shall provide additional ventilation to lower CO levels.		

Annual Electric Savings (kWh):	15,993	Annual District Energy-Hot Water Savings (Gallons):	407,045
Estimated Annual kWh Savings (\$):	\$1,143	Est Annual District Energy-Hot Water Savings (\$):	\$8,548
Contractor Cost (\$):	\$18,260		
PBEEEP Provider Cost for Implementation Assistance (\$):	\$2,970		
Total Estimated Implementation Cost (\$):	\$21,230		

Estimated Annual Total Savings (\$):	\$9,691	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	2.19	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	2.19	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO ₂ e):	43	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	9.9%	Percent of Implementation Costs:	2.5%

Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	14
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	All AHU heating valves are open when units are off.	Date Identified:	3/4/2011
Description of Finding:	Trends show the MAU-1 heating valve is at 50% open and the AHU-1 heating valve is at 100% open during unoccupied times. Temperatures reach upwards of 120 degrees in the unit during these times. This is much warmer than required to prevent the coil from freezing.		
Equipment or System(s):	AHU with heating only	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	In-house staff	Benefits:	Energy savings due to reduced pumping of heating water to coils in inactive air handlers.
Baseline Documentation Method:	Trending/data logging of discharge temperature and valve position		
Measure:	Apply a freeze protection program to prevent coil failure instead of overriding valve to 50%.		
Recommendation for Implementation:	Fix applies to AHU-1 and MAU-1. Program an unoccupied mixed air plenum override for the heating coil valve. If the MAT falls below 45F (adj.) modulate the heating valve open to maintain mixed air temperature setpoint.		
Evidence of Implementation Method:	Applies to AHU-1 and MAU-1. Trending and functional testing. Trend pre-heat temperature sensor and heating valve position. Verify AHU coil section temperature setpoint is maintained. Functional test by increasing freeze-prevention setpoint to be above the current temperature in that location. Verify heating valve modulates open to prevent coil freeze.		

Annual Electric Savings (kWh):	6,526	Annual District Energy-Hot Water Savings (Gallons):	118,924
Estimated Annual kWh Savings (\$):	\$266	Est Annual District Energy-Hot Water Savings (\$):	\$2,497
Contractor Cost (\$):	\$1,683		
PBEEP Provider Cost for Implementation Assistance (\$):	\$297		
Total Estimated Implementation Cost (\$):	\$1,980		

Estimated Annual Total Savings (\$):	\$2,763	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.72	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.72	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO ₂ e):	14	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.8%	Percent of Implementation Costs:	0.2%

Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	15
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	MAU-1 space temperature maintained above setpoint	Date Identified:	3/4/2011
Description of Finding:	Trends show space temperature setpoint is 55 degrees and the space temperature readings indicate space temperature is not controlled. The space temperature continues to rise above the space setpoint and peaks when the unit is turned off for unoccupied hours.		
Equipment or System(s):	AHU with heating only	Finding Category:	Controls Problems
Finding Type:	Other Controls		

Implementer:	Contractor	Benefits:	Energy savings due to reduced heating load.
Baseline Documentation Method:	Trending/data logging of discharge temperature and space temperature		
Measure:	Program a discharge air sequence to control space setpoint of 55 dg F.		
Recommendation for Implementation:	Solicit a controls contractor to program a discharge air temperature reset based on outside air temperature and space temperature setpoint. Setpoint reset range to be 65F (adj.) at outside temperature of 45F and 85F (adj.) at 0F outside temperature.		
Evidence of Implementation Method:	Trending and functional testing. Trend space temperature and AHU discharge temperature and verify space setpoint is maintained. Trending to occur for a minimum of three weeks from Jan 1 to March 1. Trending interval to be 15 minutes or less Functional test by adjusting space temperature setpoint and observe the AHU discharge setpoint change appropriately.		

Annual District Energy-Hot Water Savings (Gallons):	60,216	Contractor Cost (\$):	\$2,332
Est Annual District Energy-Hot Water Savings (\$):	\$1,265	PBEEP Provider Cost for Implementation Assistance (\$):	\$1,188
		Total Estimated Implementation Cost (\$):	\$3,520

Estimated Annual Total Savings (\$):	\$1,265	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	2.78	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	2.78	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO ₂ e):	4	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.3%	Percent of Implementation Costs:	0.4%

Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	24
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	DDC VAV upgrade and space setpoint measures combined for AHUs 1,2,3,7, and 8	Date Identified:	2/2/2012
Description of Finding:	Combines FWB items 4, 8, 10, 19, 20, and 21.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls Problems
Finding Type:	Other Controls		

Implementer:	Contractor	Benefits:	Heating, Cooling, and Electrical Energy savings due to reduced AHU fan speeds. Improved occupant comfort. Reduced maintenance/operating costs. Space temperature setpoint control at the BAS. VAVs/Zones can be scheduled based on occupancy. A dynamic duct static pressure reset could be implemented to reset based on VAV demand.
Baseline Documentation Method:	Trending of AHU fan speeds, visual observation of VFDs, discussions with site staff, and VAV testing.		
Measure:	Upgrade VAV control to DDC and rebalance supply/return airflows.		
Recommendation for Implementation:	Solicit both controls and balancing contractors to remove existing pneumatic VAV controllers, damper actuators, reheat valves/actuators. Install new DDC controllers, damper actuators, reheat valves/actuators, wiring, temperature sensors, program design heating and cooling airflows, and rebalance supply and return ducts based on the most recent design values. This work includes all 424 VAVs supplied by all variable air volume AHUs. Program space temperature setpoints to 70F (adj.) in heating and 74F (adj.) in cooling.		
Evidence of Implementation Method:	Trending and functional testing. Trending of the AHU VFD speeds and duct static readings in multiple seasons. Trending duration to be a minimum of 3 weeks at an interval of 15 min or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.		

Annual Electric Savings (kWh):	406,870	Peak Demand Savings (kWh):	129
Estimated Annual kWh Savings (\$):	\$27,512	Estimated Annual Demand Savings (\$):	\$0
Annual District Energy-Chilled Water Savings (kBtu):	426,301	Annual District Energy-Hot Water Savings (Gallons):	750,454
Est Annual District Energy-Chilled Water Savings (\$):	\$4,263	Est Annual District Energy-Hot Water Savings (\$):	\$15,760
Contractor Cost (\$):	\$702,398		
PBEEEP Provider Cost for Implementation Assistance (\$):	\$47,223		
Total Estimated Implementation Cost (\$):	\$749,621		

Estimated Annual Total Savings (\$):	\$47,534	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	15.77	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	15.77	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	431	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	48.7%	Percent of Implementation Costs:	88.5%

Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	31
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-2 return section has significant gaps.	Date Identified:	2/8/2012
Description of Finding:	An investigation with site staff was conducted to determine why the sub-basement mechanical room pressure is negative which is causing air to be pulled from the elevator shaft and through gaps around sub-basement exterior doors. To help alleviate this problem site staff have opened a sub-basement exterior door to allow outside air to be drawn into the space and has reduced the draw from surrounding spaces. This investigation found that on top of the return section of AHU-2 there is a large gap between the top portion of the ductwork and the wall. Also, the penetrations through the floor from basement to sub-basement, in the return section, are not sleeved and sealed. There is also a section of the AHUs return plenum which has not been completely walled off. This section can be reached through an access panel in the outdoor air section of AHU-2. To the south of this access panel is an opening which should be walled off because it is open to non air duct portions of the duct riser and there are several pipe penetrations through a block wall which is the north wall of the garage. This causes some of AHU-2s return air to be air from the garage space.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Mechanical Contractor or Site staff.	Benefits:	Energy savings due to reduced outside air ventilation. Improved air quality.
Baseline Documentation Method:	Field verification/investigation with site staff. Photos and drawings showing where the leaks/gaps are.		
Measure:	Cover and seal the gap on top of the AHUs return section. Sleeve and seal the return air penetrations between basement and sub-basement floors to the AHU. Wall off and seal the opening in the return plenum that is above the OA section.		
Recommendation for Implementation:	Sleeve and seal the return duct penetrations from the basement to sub-basement return air plenum. Wall off and seal section in RA plenum above the OA plenum that allows air to be pulled from the garage. Patch and seal RA duct/plenum on top of AHU.		
Evidence of Implementation Method:	Photos of completed work.		

Annual District Energy-Chilled Water Savings (kBtu):	20,179	Annual District Energy-Hot Water Savings (Gallons):	58,701
Est Annual District Energy-Chilled Water Savings (\$):	\$202	Est Annual District Energy-Hot Water Savings (\$):	\$1,233
Contractor Cost (\$):	\$1,903		
PBEEEP Provider Cost for Implementation Assistance (\$):	\$297		
Total Estimated Implementation Cost (\$):	\$2,200		

Estimated Annual Total Savings (\$):	\$1,435	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	1.53	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	1.53	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	6	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.5%	Percent of Implementation Costs:	0.3%

Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	32
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU Scheduling Combined	Date Identified:	2/20/2012
Description of Finding:	Combines FWB items 3, 5, 16, 23, 26, and 27.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	In-house staff	Benefits:	Energy savings due to reduced hours of operation for all HVAC equipment.
Baseline Documentation Method:	Trending of fan operation		
Measure:	Utilize a night setback sequence which activates the AHUS if the average space temperature is too low instead of manually overriding the unit on 24/7 when outside air temps are low.		
Recommendation for Implementation:	See Items 3, 5, 16, 23, 26, and 27 for detailed recommendations for each AHU.		
Evidence of Implementation Method:	See Items 3, 5, 16, 23, 26, and 27 for detailed description.		

Annual Electric Savings (kWh):	52,848	Annual District Energy-Hot Water Savings (Gallons):	885,555
Estimated Annual kWh Savings (\$):	\$2,412	Est Annual District Energy-Hot Water Savings (\$):	\$18,597
Contractor Cost (\$):	\$12,166		
PBEEP Provider Cost for Implementation Assistance (\$):	\$3,564		
Total Estimated Implementation Cost (\$):	\$15,730		

Estimated Annual Total Savings (\$):	\$21,009	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.75	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.75	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	110	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	21.5%	Percent of Implementation Costs:	1.9%

Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	33
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU OA Control Combined	Date Identified:	2/20/2012
Description of Finding:	Combines FWB items 9, 12, 28, 29, and 30.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls and Balancing Contractors	Benefits:	Energy savings due to reduced outside air ventilation.
Baseline Documentation Method:	Trending of OAT, RAT, MAT and OA damper position.		
Measure:	Provide minimum outside air control based on CO2 levels and negative mixing box strategies.		
Recommendation for Implementation:	See Items 9, 12, 28, 29 and 30 for detailed recommendations for each AHU.		
Evidence of Implementation Method:	See Items 9, 12, 28, 29, and 30.		

Annual District Energy-Chilled Water Savings (kBtu):	52,674	Annual District Energy-Hot Water Savings (Gallons):	487,387
Est Annual District Energy-Chilled Water Savings (\$):	\$527	Est Annual District Energy-Hot Water Savings (\$):	\$10,235
Contractor Cost (\$):	\$29,920		
PBEEP Provider Cost for Implementation Assistance (\$):	\$11,880		
Total Estimated Implementation Cost (\$):	\$41,800		

Estimated Annual Total Savings (\$):	\$10,762	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	3.88	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	3.88	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	39	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	11.0%	Percent of Implementation Costs:	4.9%

Baseline Documentation Method	Trending of AHU fan speeds, visual observation of VFDs, discussions with site staff, and VAV testing. Trending of VFD speed, supply duct static pressure and visual observation VAV functional testing to determine if heating airflows are correct. Site Observation and photograph
Measure	Upgrade VAV control to DDC and rebalance supply/return airflows. Replace OA damper and actuator. Change setpoints seasonally to the appropriate heating and cooling
Recommendations for Implementation	Solicit both controls and balancing contractors to remove existing pneumatic VAV controllers, damper actuators, reheat valves/actuators. Install new DDC controllers, damper actuators, reheat valves/actuators, wiring, temperature sensors, program design heating and cooling airflows, and rebalance supply and return ducts based on the most recent design values. This work includes all 424 VAVs supplied by all variable air volume AHUs. (39 for AHU-1, 144 for AHU-2, 172 for AHU-3 and 35 for S-7). Program space temperature setpoints to 70F (adj.) in heating and 74F (adj.) in cooling. For S-7, Also, remove and replace existing differential pressure sensor with a new sensor. Verify location and installation are per manufacture's recommendation. Contractor is to calibrate sensor.

Finding Number	Description of Finding	Evidence of Implementation: Method
24	Combines FWB items 4, 8, 10, 19, 20, and 21.	Trending and functional testing. Trending of the AHU VFD speeds and duct static readings in multiple seasons. Trending duration to be a minimum of 3 weeks at an interval of 15 min or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.
	Visual observation of the VFD was that the fan speed did not modulate. Trending confirmed this occurs during all occupied hours. VAV airflow testing revealed the pneumatic controllers are out of calibration/failing and the air balance is not correct.	Trending and functional testing. Trending of the AHU VFD speeds and duct static readings in multiple seasons. Trending of at least 10% of the VAVs connected to AHU 1. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Each trend set duration to be at least 3 weeks and the trend interval to be 15 min or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.
	The VFD for AHU-2 is operating at 98-100% during occupied hours in the heating season. Typical operation of this type of system is 40-60% VFD speeds during the heating season. Possible causes are failed VAVs, incorrect discharge air temperature setpoint, balancing dampers, failed differential pressure sensor. VAV testing has determined there is a building wide issue with VAV 8 airflow calibration and balancing.	Trending and functional testing. Trending of the AHU VFD speeds, duct static readings, and outdoor air conditions in multiple seasons. Trending of at least 10% of the VAVs connected to AHU 2. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Trend shall occur for a minimum of three weeks in each season (Winter, Shoulder, Summer). Trending interval to be 15 minutes or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.
	The VFD for AHU-3 is operating at 98-100% during occupied hours in the heating season. Typical operation of this type of system is 40-60% VFD speeds during the heating season. Possible causes are failed VAVs, incorrect discharge air temperature setpoint, balancing dampers, failed differential pressure sensor.	Trending and functional testing. Trending of the AHU VFD speeds, duct static readings, and outdoor air conditions in multiple seasons. Trending of at least 10% of the VAVs connected to AHU 3. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Trend shall occur for a minimum of three weeks in each season (Winter, Shoulder, Summer). Trending interval to be 15 minutes or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.
	A random sampling of VAVs on 7th floor revealed that the min and max flow setpoints are out of calibration and the balancing at the supply diffusers is not at design. Also the supply duct static sensor for the AHU is out of calibration/failed.	Trending and functional testing. Trending of the AHU VFD speeds, duct static readings, and outdoor air conditions in multiple seasons. Trending of at least 10% of the VAVs connected to S-7. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Trend differential pressure sensor and fan VFD speed. Verify differential pressure is maintained while VFD modulates based on demand. Functional test unit by adjusting differential setpoint and verify VFD modulation to maintain setpoint. Trend shall occur for a minimum of three weeks in each season (Winter, Shoulder, Summer). Trending interval to be 15 minutes or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.
	A random sampling of VAVs on 7th floor revealed that the min and max flow setpoints are out of calibration and the balancing at the supply diffusers is not at design.	Trending and functional testing. Trending of the AHU VFD speeds, duct static readings, and outdoor air conditions in multiple seasons. Trending of at least 10% of the VAVs connected to S-8. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Trend shall occur for a minimum of three weeks in each season (Winter, Shoulder, Summer). Trending interval to be 15 minutes or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.
	The thermostats throughout the building are mostly pneumatic and can only be adjusted manually. Currently most are set to 72 and are left at that setpoint all year. This measure is now combined with measure 24 due to the nature of pneumatic thermostats and adjusting setpoints. Trending of return air temperatures revealed that space temperatures are 74-76F during the heating season and 74F during the cooling season.	For setpoint change using existing T-Stats a site visit report, with photographs. If new DDC sensors are installed verify setpoints on BAS computer and take screenshots of values.

Baseline Documentation Method	Trending of fan operation. Trending of MAU discharge temperature and valve position. Trending of fan operation. Trending of supply fan VFD
Measure	Utilize a night setback sequence which activates the AHUS if the average space temperature is too low instead of manually overriding the unit on 24/7 when outside air temps are low.
Recommendations for Implementation	Solicit a controls contractor to install at least 2 space sensors in the garage, add a new discharge air temperature probe in the MUA unit and program a night setback sequence which activates the AHUs when the average space temperature is too low. Suggested space sensors to monitor for a night setback are connected to VAVs 7-2, 5, 17, 20, 22 and 31. A typical night setback temperature setpoint is 55 deg F. This setback temperature is to be monitored using a perimeter space sensor or sensors which are already in place. There are several pneumatic VAVs which have been upgraded to DDC and have electronic space sensors which are already monitored by the BAS. Suggested space sensors to monitor for a night setback are connected to VAVs G-37, 1-41, 3-1, 3-9, 4-16, 5-5, 5-7, 6-5, and 6-7. A typical night setback temperature setpoint is between 55-60 deg F (adj.) depending on how quickly the AHU can return the space temperature to the occupied setpoint. There are some pneumatic VAVs which have been upgraded to DDC and have electronic space sensors which are already monitored by the BAS. Suggested space sensors to monitor for a night setback are connected to VAVs G-21, 22, 25, 30, and 1-73. VAVs 1-11, 15, 1, 2-28, 35, 3-38, 4-40, 6-20 and 22, 8-65 and 66.

Finding Number	Description of Finding	Evidence of Implementation: Method
32	Combines FWB items 3, 5, 16, 23, 26, and 27. The make-up air unit for the underground garage operated 24/7 for the week of 2/7-2/11 to offset the air removed by the exhaust fans which also operated 24/7. 3 Week 2/14 ON at 5:00am OFF at 5:30pm. Fan scheduling is inconsistent from week to week. First week of trending fans run 24 hours M-F and off Sat-Sun then on 5:30am-5:30pm weekdays after that. This is likely to prevent low space temperatures during unoccupied hours. Data loggers in spaces indicate temperatures did not fall below 68F during unoccupied hours even when AHUs were off.	See Items 3, 5, 16, 23, 26, and 27 for detailed description. Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trending duration to be a minimum of 3 weeks and occur during Jan 1 - March 1. Trending interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature. Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trend duration is a minimum of 3 weeks during the months of Jan 1 - March 1. Trend interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.
5	Trending indicates the unit is operating 24 hours per day during the week, off starting Saturday at 7:00 am, start again at 6:00am Monday, then 19 hours per day for the next week. Unit may have been manually set to different occupied hours due to the low OA temps. Based on the reaction of the building while the units are off on the weekend suggest this is not necessary.	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trending duration shall be a minimum of 3 weeks and occur between Jan 1 and March 1. The trending interval to be 15 minutes or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.
23	Fan scheduling is inconsistent from week to week. First week of trending fans run 24 hours M-F and off Sat-Sun then on 5:30am-5:30pm weekdays after that. This is likely to prevent low space temperatures during unoccupied hours. Data loggers in spaces indicate temperatures did not fall below 68F during unoccupied hours even when AHUs were off.	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trend duration is a minimum of 3 weeks during the months of Jan 1 - March 1. Trend interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.
26	Fan scheduling is inconsistent from week to week. First week of trending fans run 24 hours M-F and off Sat-Sun then on 5:30am-5:30pm weekdays after that. This is likely to prevent low space temperatures during unoccupied hours. Data loggers in spaces indicate temperatures did not fall below 68F during unoccupied hours even when AHUs were off.	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trend duration is a minimum of 3 weeks during the months of Jan 1 - March 1. Trend interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.
27	Fan scheduling is inconsistent from week to week. First week of trending fans run 24 hours M-F and off Sat-Sun then on 5:30am-5:30pm weekdays after that. This is likely to prevent low space temperatures during unoccupied hours. Data loggers in spaces indicate temperatures did not fall below 68F during unoccupied hours even when AHUs were off.	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trend duration is a minimum of 3 weeks during the months of Jan 1 - March 1. Trend interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.

Baseline Documentation	Method	Trending of OAT, RAT, MAT and OA damper position. Trending and point to point check for calibration. Trending and point to point verification of damper position
	Measure	Provide minimum outside air control based on CO2 levels and negative mixing box strategies. Replace CO2 sensor and program minimum outside air override based on CO2 levels. Provide new min OA controls.
	Recommendations for Implementation	<p>1. To set and maintain the minimum ventilation requires a balancer and a controls contractor. A negative pressure mixing box controls strategy shall be used to maintain minimum outside air. To do so requires installing a differential pressure sensor which measures the DP across the OA damper. Control of the RA and OA dampers to be independent requires separate analog outputs to each damper. Then with the AHU at max supply flow adjust the OA and RA damper positions in opposition until the minimum outside air volume is achieved. At this point the OA damper minimum position is determined/programmed. The differential pressure across the OA damper, at minimum position, is now the setpoint for RA damper control. The RA damper shall modulate to maintain the balancer determined DP setpoint across the OA damper during all occupied modes of operation. This ensures that the required ventilation is maintained at all fan speeds. # 9 Based on current space use, square footage, and occupancy the initial minimum ventilation is 9454CFM (adj.). #12 Based on current space use, square footage, and occupancy the initial minimum ventilation is 9174CFM (adj.), # 28: 9174CFM, #29: 2920 CFM (adj.). Ensure all physical and logical duct static safeties (Low return static) are in place and functional. 2. Controls contractor to remove and replace existing CO2 sensor and provide programming for overriding minimum outside air ventilation based on building CO2 levels. When return air CO2 levels are below 500PPM + Ambient PPM the OA dampers to control for economizing. Upon CO2 detection above the calculated setpoint the unit increases OA intake to reduce CO2 levels in the return air. Verify occupant counts at the time of implementation and re-evaluate the appropriate minimum ventilation rates.</p>

Finding Number	Description of Finding	Evidence of Implementation: Method
33	Combines FWB items 9, 12, 28, 29, and 30.	See Items 9, 12, 28, 29, and 30.
	Trending of CO2 sensor and outside air damper, return air damper, return air temperature, mixed air temperature, outside air temperature, OA damper differential pressure and the supply fan status/VFD speed. Trending shall occur during the season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO2 sensor using a know concentration of CO2 test gas to verify sensor reading. Also, test CO2 override when levels rise above setpoint. When CO2 setpoint is exceeded the unit shall provide additional ventilation to lower CO2 levels. Functional test sequence for maintaining minimum outside air ventilation. Functional test physical/logical duct static safeties.	
9	Trended value for CO2 always reads 1997.56. Sensor should be replaced. Also, the minimum ventilation rate is much higher than required by ASHRAE 62.1	
12	Trending of the CO2 sensor produced values between 1350-1700 ppm and nothing lower. AHU relief and outside air damper positions suggest that this reading should be much lower.	Trending of CO2 sensor and outside air damper. Trending shall occur during any season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO2 sensor using a know concentration of CO2 test gas to verify sensor reading. Also, test CO2 override when levels rise above setpoint. When CO2 setpoint is exceeded the unit shall provide additional ventilation to lower CO2 levels.
28	Trending indicates the minimum outside air setpoint/damper introduces more outside air to the spaces than required. Based the trends the minimum ventilation was found to be 23% of max supply.	Trending of CO2 sensor and outside air damper, return air damper, return air temperature, mixed air temperature, outside air temperature, OA damper differential pressure and the supply fan status/VFD speed. Trending shall occur during the season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO2 sensor using a know concentration of CO2 test gas to verify sensor reading. Also, test CO2 override when levels rise above setpoint. When CO2 setpoint is exceeded the unit shall provide additional ventilation to lower CO2 levels. Functional test sequence for maintaining minimum outside air ventilation. Functional test physical/logical duct static safeties.
29	Trending indicates the minimum outside air setpoint/damper introduces more outside air to the spaces than required. Based the trends the minimum ventilation was found to be 22% of max supply.	same
30	Trending indicates the minimum outside air setpoint/damper introduces more outside air to the spaces than required. Based the trends the minimum ventilation was found to be 14% of max supply.	same



Deleted Findings Summary

Site: Transportation Building

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
21	Transportation Building	Building space temperature setpoint is approximately 72 deg F all year	\$4,300	\$1,702	2.53	\$0	2.53	6
1	Transportation Building	Domestic hot water heat exchangers have limited control. Due to lengthy payback this measure is no	\$0	\$0	0.00	\$0	0.00	0
2	Transportation Building	AHU-2 OA Damper. MEASURE NO LONGER VIEWED AS AN ISSUE. OA ISSUES ARE DIRECTLY RELATED TO FAILED VA	\$0	\$0	0.00	\$0	0.00	0
3	Transportation Building	MAU-1 for Garage operates on an inconsistent schedule. COMBINED WITH OTHER MEASURES, SEE FWB# 32 FO	\$0	\$0	0.00	\$0	0.00	0
4	Transportation Building	AHU-1 supply fan VFD always at 100% speed	\$0	\$0	0.00	\$0	0.00	0
5	Transportation Building	AHU-2 scheduling is not consistent. COMBINED WITH OTHER MEASURES, SEE FWB# 32 FOR SAVINGS/COST/PAYBA	\$0	\$0	0.00	\$0	0.00	0
7	Transportation Building	AHU-2 Relief static pressure was negative. NO LONGER VIEW AS AN ISSUE WITH THE RELIEF CONTROL	\$0	\$0	0.00	\$0	0.00	0
8	Transportation Building	AHU-2 supply and return fan VFD speed is high for the heating season.	\$0	\$0	0.00	\$0	0.00	0
9	Transportation Building	AHU-2 CO2 Sensor and minimum ventilation control not working.	\$0	\$0	0.00	\$0	0.00	0
10	Transportation Building	AHU-3 supply and return fan VFD speed is high for the heating season	\$0	\$0	0.00	\$0	0.00	0
11	Transportation Building	AHU-3 economizer temperature setpoint is high.	\$0	\$0	0.00	\$0	0.00	0
12	Transportation Building	AHU-3 CO2 Sensor out of calibration.	\$0	\$0	0.00	\$0	0.00	0
16	Transportation Building	SF-7 scheduling is inconsistent. COMBINED WITH OTHER MEASURES, SEE FWB# 32 FOR SAVINGS/COST/PAYBACK	\$0	\$0	0.00	\$0	0.00	0



Deleted Findings Summary

Site: Transportation Building

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
17	Transportation Building	SF-7 Duct Static sensor out of calibration. THIS MEASURE IS NOW INCLUDED IN FWB #19	\$0	\$0	0.00	\$0	0.00	0
18	Transportation Building	SF-8 Return Air Humidity sensor has failed.	\$0	\$0	0.00	\$0	0.00	0
19	Transportation Building	SF-7 VAVs out of calibration/balance	\$0	\$0	0.00	\$0	0.00	0
20	Transportation Building	SF-8 VAVs out of calibration/balance	\$0	\$0	0.00	\$0	0.00	0
22	Transportation Building	AHU-1 Outside Air Damper sticks and won't fully close. SITE STAFF INFORMED ME THAT THIS DAMPER HAS B	\$0	\$0	0.00	\$0	0.00	0
23	Transportation Building	AHU-1 scheduling is not consistent.	\$0	\$0	0.00	\$0	0.00	0
25	Transportation Building	Pneumatic VAV controller replacement/calibration/Balance. Option 2 for FWB #24	\$0	\$0	0.00	\$0	0.00	0
26	Transportation Building	AHU-3 Scheduling	\$0	\$0	0.00	\$0	0.00	0
27	Transportation Building	SF-8 Scheduling	\$0	\$0	0.00	\$0	0.00	0
28	Transportation Building	AHU-1 minimum outside air ventilation is higher than required.	\$0	\$0	0.00	\$0	0.00	0
29	Transportation Building	S-7 minimum outside air ventilation is higher than required.	\$0	\$0	0.00	\$0	0.00	0
30	Transportation Building	S-8 minimum outside air ventilation is higher than required.	\$0	\$0	0.00	\$0	0.00	0
		Total for Findings with Payback 3 years or less:	\$4,300	\$1,702	2.53	\$0	2.53	6
		Total for all Findings:	\$4,300	\$1,702	2.53	\$0	2.53	6

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	1
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	Domestic hot water heat exchangers have limited control. Due to lengthy payback this measure is no	Date Identified:	2/27/2011
Description of Finding:	The building staff indicated domestic hot water heat exchangers do not control to a supply water temperature setpoint. They simply provide 180°F at all times. Trending indicated the typical domestic hot water supply temperatures range from 175-182F.		
Equipment or System(s):	Other	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor	Benefits:	Reduced district hot water use
Baseline Documentation Method:	Trending of DHW supply temperature and visual observation		
Measure:	Install a control valve to maintain a domestic hot water supply temperature of 120F to the kitchen.		
Recommendation for Implementation:	Install a control valve on the district hot water side of the domestic hot water heat exchanger. Provide controls programming for valve to maintain a domestic hot water supply temperature of 120F.		
Evidence of Implementation Method:	Trending and functional testing. Trending duration shall be a minimum of 3 weeks and record at an interval of 15 minutes or less. Trend the domestic hot water supply temperature and control valve position. Verify DHW temp setpoint is maintained throughout the entire trend period. Functional test by changing supply temperature setpoint and verify system controls to the new setpoint.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	2
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-2 OA Damper. MEASURE NO LONGER VIEWED AS AN ISSUE. OA ISSUES ARE DIRECTLY RELATED TO FAILED VA	Date Identified:	3/4/2011
Description of Finding:	Trending data indicates the OA damper is commanded to 100% at all times. REDUCED OA SAVINGS ARE ACCOUNTED FOR IN FWB #9 CO2 CONTROL.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor	Benefits:	Reduce energy usage by eliminating unnecessary outside air heating and cooling.
Baseline Documentation Method:	Trending of OA damper position		
Measure:	Repair OA damper function.		
Recommendation for Implementation:	Restore OA damper control. Damper should be controlled based on mixed air temperature requirements. An economizer sequence should be used to determine the amount of outside air required to achieve the mixed air temperature setpoint.		
Evidence of Implementation Method:	Trending and functional testing. Trend the OA damper position, OAT, MAT, DAT, and RAT, heating and cooling valve positions. Evaluate operation of the damper and valves to determine correct function of the economizer program. Functional test by changing MAT setpoint and evaluate OA damper function based on the previous stated change.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	3
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	MAU-1 for Garage operates on an inconsistent schedule. COMBINED WITH OTHER MEASURES, SEE FWB# 32 FO	Date Identified:	3/4/2011
Description of Finding:	The make-up air unit for the underground garage operated 24/7 for the week of 2/7-2/11 to offset the air removed by the exhaust fans which also operated 24/7. Week 2/14 ON at 5:00am OFF at 5:30pm.		
Equipment or System(s):	AHU with heating only	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Reduced Run Hours
Baseline Documentation Method:	Trending of MAU discharge temperature and valve position		
Measure:	Utilize a night setback sequence which activates the AHU if the average space temperature is too low.		
Recommendation for Implementation:	Solicit a controls contractor to install at least 2 space sensors in the garage, add a new discharge air temperature probe in the MUA unit and program a night setback sequence which activates the AHUs when the average space temperature is too low. A typical night setback temperature setpoint is 55 deg F.		
Evidence of Implementation Method:	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trending duration to be a minimum of 3 weeks and occur during Jan 1 - March 1. Trending interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	4
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-1 supply fan VFD always at 100% speed	Date Identified:	3/4/2011
Description of Finding:	Visual observation of the VFD was that the fan speed did not modulate. Trending confirmed this occurs during all occupied hours. VAV airflow testing revealed the pneumatic controllers are out of calibration/failing and the air balance is not correct.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Energy savings due to reduced AHU fan speeds. Improved occupant comfort. Reduced maintenance costs
Baseline Documentation Method:	Trending of VFD speed, supply duct static pressure and visual observation		
Measure:	Upgrade VAV control to DDC and rebalance supply/return airflows. Replace OA damper and actuator.		
Recommendation for Implementation:	Solicit both controls and balancing contractors to remove existing pneumatic VAV controllers, damper actuators, reheat valves/actuators. Install new DDC controllers, damper actuators, reheat valves/actuators, wiring, temperature sensors, program design heating and cooling airflows, and rebalance supply and return ducts based on the most recent design values. This work includes all 39 VAVs supplied by AHU-1. Program space temperature setpoints to 70F (adj.) in heating and 74F (adj.) in cooling.		
Evidence of Implementation Method:	Trending and functional testing. Trending of the AHU VFD speeds and duct static readings in multiple seasons. Trending of at least 10% of the VAVs connected to AHU 1. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Each trend set duration to be at least 3 weeks and the trend interval to be 15 min or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO ₂ e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	5
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-2 scheduling is not consistent. COMBINED WITH OTHER MEASURES, SEE FWB# 32 FOR SAVINGS/COST/PAYBA	Date Identified:	3/4/2011
Description of Finding:	Fan scheduling is inconsistent from week to week. First week of trending fans run 24 hours M-F and off Sat-Sun then on 5:30am-5:30pm weekdays after that. This is likely to prevent low space temperatures during unoccupied hours. Data loggers in spaces indicate temperatures did not fall below 68F during unoccupied hours even when AHUs were off.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Energy savings due to reduced hours of operation for all HVAC equipment.
Baseline Documentation Method:	Trending of fan operation		
Measure:	Utilize a night setback sequence which activates the AHUS if the average space temperature is too low instead of manually overriding the unit on 24/7 when outside air temps are low.		
Recommendation for Implementation:	Solicit a controls contractor to program a night setback sequence which activates the AHUs when the space temperature is too low. This setback temperature is to be monitored using a perimeter space sensor or sensors which are already in place. There are several pneumatic VAVs which have been upgraded to DDC and have electronic space sensors which are already monitored by the BAS. Suggested space sensors to monitor for a night setback are connected to VAVs G-37, 1-41, 3-1, 3-9, 4-16, 5-5, 5-7, 6-5, and 6-7. A typical night setback temperature setpoint is between 55-60 deg F (adj.) depending on how quickly the AHU can return the space temperature to the occupied setpoint.		
Evidence of Implementation Method:	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trend duration is a minimum of 3 weeks during the months of Jan 1 - March 1. Trend interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	7
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-2 Relief static pressure was negative. NO LONGER VIEW AS AN ISSUE WITH THE RELIEF CONTROL	Date Identified:	3/4/2011
Description of Finding:	Trending data for the relief static pressure shows the pressure was negative from 5:30am 2/7 to 2:30pm 2/11. The relief damper control/PID loop are cause the damper to hunt and not maintain relief pressure setpoint. Also the relief plenum pressure sensor consistently reads the same pressure when the AHU is not operating. Sensor is likely bad. After more investigation it was determined that the relief dampers are operating as intended to control the relief static pressure. The issue as noted is caused by the failed VAVs associated with this AHU which cause it to operate at maximum capacity. Under these conditions the AHUs return fan is not capable of returning 100% of the air supplied and due to the system layout the relief section is the "path of least resistance" when additional outside air is needed to make up for the insufficient return air.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:		Benefits:	
Baseline Documentation Method:	Trending and verification testing to determine sequence of operation for controlling relief static pressure		
Measure:			
Recommendation for Implementation:			
Evidence of Implementation Method:			

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	8
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-2 supply and return fan VFD speed is high for the heating season.	Date Identified:	3/4/2011
Description of Finding:	The VFD for AHU-2 is operating at 98-100% during occupied hours in the heating season. Typical operation of this type of system is 40-60% VFD speeds during the heating season. Possible causes are failed VAVs, incorrect discharge air temperature setpoint, balancing dampers, failed differential pressure sensor. VAV testing has determined there is a building wide issue with VAV airflow calibration and balancing.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Energy savings due to reduced AHU fan speeds. Improved occupant comfort. Reduced maintenance costs
Baseline Documentation Method:	VAV functional testing to determine if heating airflows are correct		
Measure:	Upgrade VAV control to DDC and rebalance supply/return airflows.		
Recommendation for Implementation:	Solicit both controls and balancing contractors to remove existing pneumatic VAV controllers, damper actuators, reheat valves/actuators. Install new DDC controllers, damper actuators, reheat valves/actuators, wiring, temperature sensors, and program design heating and cooling airflows for all 144 VAVs connected to AHU-2. TAB contractor to rebalance supply and return ducts to most current design document airflows. Program space temperature setpoints to 70F (adj.) in heating and 74F (adj.) in cooling.		
Evidence of Implementation Method:	Trending and functional testing. Trending of the AHU VFD speeds, duct static readings, and outdoor air conditions in multiple seasons. Trending of at least 10% of the VAVs connected to AHU 2. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Trend shall occur for a minimum of three weeks in each season (Winter, Shoulder, Summer). Trending interval to be 15 minutes or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO ₂ e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	9
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-2 CO2 Sensor and minimum ventilation control not working.	Date Identified:	3/4/2011
Description of Finding:	Trended value for CO2 always reads 1997.56. Sensor should be replaced. Also, the minimum ventilation rate is much higher than required by ASHRAE 62.1		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Balancing and controls contractors	Benefits:	Energy savings due to reduced outside air ventilation.
Baseline Documentation Method:	Trending and point to point check for calibration		
Measure:	Replace CO2 sensor and program minimum outside air override based on CO2 levels. Provide new min OA controls.		
Recommendation for Implementation:	1. To set and maintain the minimum ventilation requires a balancer and a controls contractor. A negative pressure mixing box controls strategy shall be used to maintain minimum outside air. To do so requires installing a differential pressure sensor which measures the DP across the OA damper. Control of the RA and OA dampers to be independent requires separate analog outputs to each damper. Then with the AHU at max supply flow adjust the OA and RA damper positions in opposition until the minimum outside air volume is achieved. At this point the OA damper minimum position is determined/programmed. The differential pressure across the OA damper, at minimum position, is now the setpoint for RA damper control. The RA damper shall modulate to maintain the balancer determined DP setpoint across the OA damper during all occupied modes of operation. This ensures that the required ventilation is maintained at all fan speeds. Based on current space use, square footage, and occupancy the initial minimum ventilation is 9454CFM (adj.). Ensure all physical and logical duct static safeties (Low return static) are in place and functional. 2. Controls contractor to remove and replace existing CO2 sensor and provide programming for overriding minimum outside air ventilation based on building CO2 levels. When return air CO2 levels are below 500PPM + Ambient PPM the OA dampers to control for economizing. Upon CO2 detection above the calculated setpoint the unit increases OA intake to reduce CO2 levels in the return air. Verify occupant counts at the time of implementation and re-evaluate the appropriate minimum ventilation rates.		
Evidence of Implementation Method:	Trending of CO2 sensor and outside air damper, return air damper, return air temperature, mixed air temperature, outside air temperature, OA damper differential pressure and the supply fan status/VFD speed. Trending shall occur during the season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO2 sensor using a known concentration of CO2 test gas to verify sensor reading. Also, test CO2 override when levels rise above setpoint. When CO2 setpoint is exceeded the unit shall provide additional ventilation to lower CO2 levels. Functional test sequence for maintaining minimum outside air ventilation. Functional test physical/logical duct static safeties.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	10
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-3 supply and return fan VFD speed is high for the heating season	Date Identified:	3/4/2011
Description of Finding:	The VFD for AHU-3 is operating at 98-100% during occupied hours in the heating season. Typical operation of this type of system is 40-60% VFD speeds during the heating season. Possible causes are failed VAVs, incorrect discharge air temperature setpoint, balancing dampers, failed differential pressure sensor.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Energy savings due to reduced AHU fan speeds. Improved occupant comfort. Reduced maintenance costs
Baseline Documentation Method:	VAV functional testing to determine if heating airflows are correct		
Measure:	Upgrade VAV control to DDC and rebalance supply/return airflows.		
Recommendation for Implementation:	Solicit both controls and balancing contractors to remove existing pneumatic VAV controllers, damper actuators, reheat valves/actuators. Install new DDC controllers, damper actuators, reheat valves/actuators, wiring, temperature sensors, and program design heating and cooling airflows for all 172 VAVs connected to AHU-3. TAB contractor to rebalance supply and return ducts to most current design document airflows. Program space temperature setpoints to 70F (adj.) in heating and 74F (adj.) in cooling.		
Evidence of Implementation Method:	Trending and functional testing. Trending of the AHU VFD speeds, duct static readings, and outdoor air conditions in multiple seasons. Trending of at least 10% of the VAVs connected to AHU 3. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Trend shall occur for a minimum of three weeks in each season (Winter, Shoulder, Summer). Trending interval to be 15 minutes or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	11
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-3 economizer temperature setpoint is high.	Date Identified:	3/4/2011
Description of Finding:	Trends show the Economizer activation setpoint is 100°F. This setpoint will prevent the economizer from operating.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:		Benefits:	
Baseline Documentation Method:	Trending and point to point verification of damper position		
Measure:	No Measure. Shoulder season trending revealed that the Economizer setpoint was changed to 68 after the heating season was over.		
Recommendation for Implementation:			
Evidence of Implementation Method:			

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	12
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-3 CO2 Sensor out of calibration.	Date Identified:	3/4/2011
Description of Finding:	Trending of the CO2 sensor produced values between 1350-1700 ppm and nothing lower. AHU relief and outside air damper positions suggest that this reading should be much lower.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Energy savings due to reduced outside air ventilation.
Baseline Documentation Method:	Trending and point to point verification of damper position		
Measure:	Replace CO2 sensor and program outside air override based on CO2 levels.		
Recommendation for Implementation:	1. To set and maintain the minimum ventilation requires a balancer and a controls contractor. A negative pressure mixing box controls strategy shall be used to maintain minimum outside air. To do so requires installing a differential pressure sensor which measures the DP across the OA damper. Control of the RA and OA dampers to be independent requires separate analog outputs to each damper. Then with the AHU at max supply flow adjust the OA and RA damper positions in opposition until the minimum outside air volume is achieved. At this point the OA damper minimum position is determined/programmed. The DP across the OA, at minimum position, is now the setpoint for RA damper control. The RA damper shall modulate to maintain the balancer determined DP setpoint across the OA damper during all occupied modes of operation. This ensures that the required ventilation is maintained at all fan speeds. Based on current space use, square footage, and occupancy the initial minimum ventilation is 9174CFM (adj.). Ensure all physical and logical duct static safeties (Low return static) are in place and functional. 2. Controls contractor to remove and replace existing CO2 sensor and provide programming for overriding minimum outside air ventilation based on building CO2 levels. When return air CO2 levels are below 500PPM + Ambient PPM the OA dampers to control for economizing. Upon CO2 detection above the calculated setpoint the unit increases OA intake to reduce CO2 levels in the return air. Verify occupant counts at the time of implementation and re-evaluate the appropriate minimum ventilation rates.		
Evidence of Implementation Method:	Trending of CO2 sensor and outside air damper. Trending shall occur during any season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO2 sensor using a know concentration of CO2 test gas to verify sensor reading. Also, test CO2 override when levels rise above setpoint. When CO2 setpoint is exceeded the unit shall provide additional ventilation to lower CO2 levels.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	16
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	SF-7 scheduling is inconsistent. COMBINED WITH OTHER MEASURES, SEE FWB# 32 FOR SAVINGS/COST/PAYBACK	Date Identified:	3/4/2011
Description of Finding:	Trending indicates the unit is operating 24 hours per day during the week, off starting Saturday at 7:00 am, start again at 6:00am Monday, then 19 hours per day for the next week. Unit may have been manually set to different occupied hours due to the low OA temps. Based on the reaction of the building while the units are off on the weekend suggest this is not necessary.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	In-house staff	Benefits:	Energy savings due to reduced hours of operation for all HVAC equipment.
Baseline Documentation Method:	Trending of supply fan VFD		
Measure:	Utilize a night setback sequence which activates the AHUS if the average space temperature is too low instead of manually overriding the unit on 24/7 when outside air temps are low.		
Recommendation for Implementation:	Solicit a controls contractor to program a night setback sequence which activates the AHUs when the average space, or critical zone, temperature is too low. There are some pneumatic VAVs which have been upgraded to DDC and have electronic space sensors which are already monitored by the BAS. Suggested space sensors to monitor for a night setback are connected to VAVs 7-2, 5, 17, 20, 22 and 31. A typical night setback temperature setpoint is between 55-60 deg F (adj.) depending on how quickly the AHU can return the space temperature to the occupied setpoint.		
Evidence of Implementation Method:	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trending duration shall be a minimum of 3 weeks and occur between Jan 1 and March 1. The trending interval to be 15 minutes or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	17
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	SF-7 Duct Static sensor out of calibration. THIS MEASURE IS NOW INCLUDED IN FWB #19	Date Identified:	3/4/2011
Description of Finding:	Trending of the duct static sensor revealed that the sensor is reading a constant 0.128" when the unit is off.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:		Benefits:	
Baseline Documentation Method:	Trending and visual observation		
Measure:	Replace duct static pressure sensor included in FWB#19		
Recommendation for Implementation:			
Evidence of Implementation Method:			

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	18
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	SF-8 Return Air Humidity sensor has failed.	Date Identified:	3/4/2011
Description of Finding:	Trending indicates the return air humidity is 10.4% all year. Since the Humidifier for this unit was never active this measure does not have any savings associated with it at this time. If the humidifier is ever used in the future this sensor must be replaced. For these reasons this measure is deleted from the PBEEP Findings Workbook and will be recommended in a supplemental report.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor	Benefits:	Prevent humidification when not needed.
Baseline Documentation Method:	Trending and visual observation		
Measure:	Replace RAH sensor.		
Recommendation for Implementation:	Solicit a controls contractor to remove and replace the return air humidity sensor for SF-8. Verify location, installation, and calibration are per manufacture's recommendation.		
Evidence of Implementation Method:	Photos of completed work. Trending of RAH sensor for a minimum of 3 weeks at an interval of 15 minutes or less.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	19
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	SF-7 VAVs out of calibration/balance	Date Identified:	5/12/2011
Description of Finding:	A random sampling of VAVs on 7th floor revealed that the min and max flow setpoints are out of calibration and the balancing at the supply diffusers is not at design. Also the supply duct static sensor for the AHU is out of calibration/failed.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Energy savings due to reduced AHU fan speeds. Improved occupant comfort. Reduced maintenance costs
Baseline Documentation Method:	VAV functional testing		
Measure:	Upgrade VAV control to DDC and rebalance supply/return airflows.		
Recommendation for Implementation:	Solicit both controls and balancing contractors to remove existing pneumatic VAV controllers, damper actuators, reheat valves/actuators. Install new DDC controllers, damper actuators, reheat valves/actuators, wiring, temperature sensors, program design heating and cooling airflows, and rebalance supply and return ducts based on the most recent design values. This work includes all 35 VAVs supplied by S-7. Program space temperature setpoints to 70F (adj.) in heating and 74F (adj.) in cooling. Also, remove and replace existing differential pressure sensor with a new sensor. Verify location and installation are per manufacture's recommendation. Contractor is to calibrate sensor.		
Evidence of Implementation Method:	Trending and functional testing. Trending of the AHU VFD speeds, duct static readings, and outdoor air conditions in multiple seasons. Trending of at least 10% of the VAVs connected to S-7. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Trend differential pressure sensor and fan VFD speed. Verify differential pressure is maintained while VFD modulates based on demand. Functional test unit by adjusting differential setpoint and verify VFD modulation to maintain setpoint. Trend shall occur for a minimum of three weeks in each season (Winter, Shoulder, Summer). Trending interval to be 15 minutes or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	20
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	SF-8 VAVs out of calibration/balance	Date Identified:	5/12/2011
Description of Finding:	A random sampling of VAVs on 7th floor revealed that the min and max flow setpoints are out of calibration and the balancing at the supply diffusers is not at design.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Energy savings due to reduced AHU fan speeds. Improved occupant comfort. Reduced maintenance costs
Baseline Documentation Method:	VAV functional testing		
Measure:	Upgrade VAV control to DDC and rebalance supply/return airflows.		
Recommendation for Implementation:	Solicit both controls and balancing contractors to remove existing pneumatic VAV controllers, damper actuators, reheat valves/actuators. Install new DDC controllers, damper actuators, reheat valves/actuators, wiring, temperature sensors, program design heating and cooling airflows, and rebalance supply and return ducts based on the most recent design values. This work includes all 34 VAVs supplied by S-8. Program space temperature setpoints to 70F (adj.) in heating and 74F (adj.) in cooling.		
Evidence of Implementation Method:	Trending and functional testing. Trending of the AHU VFD speeds, duct static readings, and outdoor air conditions in multiple seasons. Trending of at least 10% of the VAVs connected to S-8. VAV points to be trended include space temp/setpoint, damper position, reheat valve position, airflow/setpoint. Trend shall occur for a minimum of three weeks in each season (Winter, Shoulder, Summer). Trending interval to be 15 minutes or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	21
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	Building space temperature setpoint is approximately 72 deg F all year	Date Identified:	5/12/2011
Description of Finding:	The thermostats throughout the building are mostly pneumatic and can only be adjusted manually. Currently most are set to 72 and are left at that setpoint all year. This measure is now combined with measure 24 due to the nature of pneumatic thermostats and adjusting setpoints. Trending of return air temperatures revealed that space temperatures are 74-76F during the heating season and 74F during the cooling season.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	in-house staff	Benefits:	Energy savings due to less reheat and slower fan speeds.
Baseline Documentation Method:	Site Observation and photograph		
Measure:	Change setpoints seasonally to the appropriate heating and cooling setpoints		
Recommendation for Implementation:	Set thermostats to 70 deg F during the heating season and 74-76 deg F during the cooling season. Due to poor thermostat locations throughout the building some areas may require different setpoints to ensure that all spaces associated with each VAV are satisfied. This measure does not require the implementation of DDC VAV control throughout the building but can be implemented more effectively if it is. Currently most T-stats are local control only and would require building staff to go to each one to change the setpoints seasonally. Costs are based on in-house staff taking an average of 15 min per thermostat (351 pneumatic) at \$23/hour. This amounts to 88 hrs of setpoint changing for summer and winter, which is a total of 196 hr each year. Based on the payback beyond 1 year shown in this workbook, this setpoint change can only be implemented as part of a DDC upgrade to the VAVs.		
Evidence of Implementation Method:	For setpoint change using existing T-Stats a site visit report. with photographs. If new DDC sensors are installed verify setpoints on BAS computer and take screenshots of values.		

Annual District Energy-Hot Water Savings (Gallons):	81,068	Contractor Cost (\$):	\$4,030
Est Annual District Energy-Hot Water Savings (\$):	\$1,702	PBEEEP Provider Cost for Implementation Assistance (\$):	\$270
		Total Estimated Implementation Cost (\$):	\$4,300

Estimated Annual Total Savings (\$):	\$1,702	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	2.53	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	2.53	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	6	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.7%	Percent of Implementation Costs:	0.5%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	22
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-1 Outside Air Damper sticks and won't fully close. SITE STAFF INFORMED ME THAT THIS DAMPER HAS B	Date Identified:	8/16/2011
Description of Finding:	Based on the trending it was found that the OA damper is allowing the AHU to bring in 25% of its air capacity in outside air. Functional testing and inspection of the damper showed that the damper sticks at various positions and also won't fully close.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor	Benefits:	Heating and cooling energy savings based on reduced outside air amounts during non-economizing outdoor conditions.
Baseline Documentation Method:	Trend comparison of OAT, RAT, and MAT to determine actual minimum OA CFM. Damper was also physically inspected and actuated to verify condition.		
Measure:	Replace OA damper and actuator. IT IS RECOMMENDED THAT THIS MEASURE BE IMPLEMENTAD AT THE SAME TIME AS FWB #4.		
Recommendation for Implementation:	Solicit a controls contractor to remove existing OA damper and replace with a new DDC actuated damper. Damper to have ability to close tight. Also provide airflow station to measure amount of OA provided through damper when in use. THIS WORK HAS ALREADY BEEN COMPLETED.		
Evidence of Implementation Method:	Trending and functional testing of damper operation. Trending to occur for a minimum of 3 weeks during each season (winter, shoulder, summer) to verify minimum OA and economizer functions operate in all seasons. Trending interval to be 15 min or less. Values to be trended are outside air temp, mixed air temp, return air temp, and OA damper position and airflow. Functional testing of damper and airflow station to verify minimum outside air requirements are met based on design and economizer functional.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	23
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-1 scheduling is not consistent.	Date Identified:	8/16/2011
Description of Finding:	Fan scheduling is inconsistent from week to week. First week of trending fans run 24 hours M-F and off Sat-Sun then on 5:30am-5:30pm weekdays after that. This is likely to prevent low space temperatures during unoccupied hours. Data loggers in spaces indicate temperatures did not fall below 68F during unoccupied hours even when AHUs were off.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Contractor	Benefits:	Energy savings due to reduced hours of operation for all HVAC equipment.
Baseline Documentation Method:	Trending of fan operation		
Measure:	Utilize a night setback sequence which activates the AHUS if the average space temperature is too low instead of manually overriding the unit on 24/7 when outside air temps are low.		
Recommendation for Implementation:	Solicit a controls contractor to program a night setback sequence which activates the AHUs when the average space temperature is too low. There are some pneumatic VAVs which have been upgraded to DDC and have electronic space sensors which are already monitored by the BAS. Suggested space sensors to monitor for a night setback are connected to VAVs G-21, 22, 25, 30, and 1-73 . A typical night setback temperature setpoint is between 55-60 deg F (adj.) depending on how quickly the AHU can return the space temperature to the occupied setpoint.		
Evidence of Implementation Method:	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trend duration is a minimum of 3 weeks during the months of Jan 1 - March 1. Trend interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	25
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	Pneumatic VAV controller replacement/calibration/Balance. Option 2 for FWB #24	Date Identified:	2/8/2012
Description of Finding:	Combines FWB items 4, 8, 10, 19, 20, and 21. This finding is similar to #24 as it is fix for the failing pneumatic VAVs. The difference is this finding is only a replacement of the pneumatic controllers. THIS MEASURE IS CONSIDERED A VALUE ENGINEERED VERSION OF THE DDC UPGRADE FOR VAVS. DESPITE THE MORE ATTRACTIVE PAYBACK OF THIS SOLUTION ITS CONTROL LIMITATIONS FOR OCCUPANCY CONTROL, FUTURE CUBICAL/OFFICE LAYOUTS, CANNOT CHANGE SETPOINTS/SETBACKS, AND BAS TROUBLESHOOTING/ADJUSTING WILL NOT BE AVAILABLE. FOR THESE REASONS MEASURE 24 IS THE PRIMARY RECOMMENDATION FOR REPAIRING THE VAVS. Savings*: *Note that the energy metrics have been multiplied by a factor of 0.85 to account for interaction among the measures. Electric Consumption (kWh): 345,840 Demand (kW, Summer): 28 Demand (kW, Winter): 82 District Chilled Water (kbtu): 362,356 District Hot Water (kbtu): 554,212 Total Cost (\$): 406,670 Simple Payback (years): 10.5		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEP		

Implementer:	Contractor	Benefits:	Heating, Cooling, and Electrical Energy savings due to reduced AHU fan speeds. Improved occupant comfort.
Baseline Documentation Method:	Trending of AHU fan speeds, visual observation of VFDs, discussions with site staff, and VAV testing.		
Measure:	Replace failing pneumatic controllers with new pneumatic controllers. Calibrate controllers and rebalance supply/return airflows.		
Recommendation for Implementation:	Solicit a controls contractor to remove and replace existing pneumatic controllers. When the controllers are installed VAV damper actuator and reheat valve actuators are to be tested and if they are failed replacement is required. VAV supply airflow to be balanced to the most recent construction drawing scheduled airflows. Balance return airflows based most recent construction drawing airflows.		
Evidence of Implementation Method:	Trending and functional testing. Trending of the AHU VFD speeds and duct static readings in multiple seasons. Trending duration to be a minimum of 3 weeks at an interval of 15 min or less. System modulation based on cooling/heating need is expected. Also spot check VAV balance and review/compare balancing report to system design.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	26
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-3 Scheduling	Date Identified:	2/8/2012
Description of Finding:	Fan scheduling is inconsistent from week to week. First week of trending fans run 24 hours M-F and off Sat-Sun then on 5:30am-5:30pm weekdays after that. This is likely to prevent low space temperatures during unoccupied hours. Data loggers in spaces indicate temperatures did not fall below 68F during unoccupied hours even when AHUs were off.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Controls Contractor	Benefits:	Energy savings due to reduced hours of operation for all HVAC equipment.
Baseline Documentation Method:	Trending of supply fan VFD		
Measure:	Utilize a night setback sequence which activates the AHUS if the average space temperature is too low instead of manually overriding the unit on 24/7 when outside air temps are low.		
Recommendation for Implementation:	Solicit a controls contractor to program a night setback sequence which activates the AHUs when the space temperature is too low. This setback temperature is to be monitored using a perimeter space sensor or sensors which are already in place. There are several pneumatic VAVs which have been upgraded to DDC and have electronic space sensors which are already monitored by the BAS. Suggested space sensors to monitor for a night setback are connected to VAVs 1-11, 15, 1, 2-28, 35, 3-38, 4-40, 6-20 and 22. A typical night setback temperature setpoint is between 55-60 deg F (adj.) depending on how quickly the AHU can return the space temperature to the occupied setpoint.		
Evidence of Implementation Method:	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trend duration is a minimum of 3 weeks during the months of Jan 1 - March 1. Trend interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	27
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	SF-8 Scheduling	Date Identified:	2/8/2012
Description of Finding:	Fan scheduling is inconsistent from week to week. First week of trending fans run 24 hours M-F and off Sat-Sun then on 5:30am-5:30pm weekdays after that. This is likely to prevent low space temperatures during unoccupied hours. Data loggers in spaces indicate temperatures did not fall below 68F during unoccupied hours even when AHUs were off.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Controls Contractor	Benefits:	Energy savings due to reduced hours of operation for all HVAC equipment.
Baseline Documentation Method:	Trending of supply fan VFD		
Measure:	Utilize a night setback sequence which activates the AHUS if the average space temperature is too low instead of manually overriding the unit on 24/7 when outside air temps are low.		
Recommendation for Implementation:	Solicit a controls contractor to program a night setback sequence which activates the AHUs when the space temperature is too low. This setback temperature is to be monitored using a perimeter space sensor or sensors which are already in place. There are several pneumatic VAVs which have been upgraded to DDC and have electronic space sensors which are already monitored by the BAS. Suggested space sensors to monitor for a night setback are connected to VAVs 8-65 and 66. A typical night setback temperature setpoint is between 55-60 deg F (adj.) depending on how quickly the AHU can return the space temperature to the occupied setpoint.		
Evidence of Implementation Method:	Trending and functional testing. Trend the space temperatures and activation of the AHU to determine if space temperature is maintained. Trend duration is a minimum of 3 weeks during the months of Jan 1 - March 1. Trend interval to be 15 min or less. Functional test with the unit off by adjusting the setback temperature to be above the current space temperature.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	28
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	AHU-1 minimum outside air ventilation is higher than required.	Date Identified:	2/8/2012
Description of Finding:	Trending indicates the minimum outside air setpoint/damper introduces more outside air to the spaces than required. Based the trends the minimum ventilation was found to be 23% of max supply.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Controls and Balancing Contractors	Benefits:	Energy savings due to reduced outside air ventilation.
Baseline Documentation Method:	Trending of OAT, RAT, MAT and OA damper position.		
Measure:	Provide minimum outside air control based on CO2 levels and negative mixing box strategies.		
Recommendation for Implementation:	<p>1. To set and maintain the minimum ventilation requires a balancer and a controls contractor. A negative pressure mixing box controls strategy shall be used to maintain minimum outside air. To do so requires installing a differential pressure sensor which measures the DP across the OA damper. Control of the RA and OA dampers to be independent requires separate analog outputs to each damper. Then with the AHU at max supply flow adjust the OA and RA damper positions in opposition until the minimum outside air volume is achieved. At this point the OA damper minimum position is determined/programmed. The DP across the OA, at minimum position, is now the setpoint for RA damper control. The RA damper shall modulate to maintain the balancer determined DP setpoint across the OA damper during all occupied modes of operation. This ensures that the required ventilation is maintained at all fan speeds. Based on current space use, square footage, and occupancy the initial minimum ventilation is 9174CFM (adj.). Ensure all physical and logical duct static safeties (Low return static) are in place and functional. OA damper/economizer function shall control mixed air temperature when in economizer mode. 2. Controls contractor to remove and replace existing CO2 sensor and provide programming for overriding minimum outside air ventilation based on building CO2 levels. When return air CO2 levels are below 500PPM + Ambient PPM the OA dampers to be at minimum position or control for economizing. Upon CO2 detection above the calculated setpoint the unit increases OA intake to reduce CO2 levels in the return air. Verify occupant counts at the time of implementation and re-evaluate the appropriate minimum ventilation rates.</p>		
Evidence of Implementation Method:	Trending of CO2 sensor and outside air damper, return air damper, return air temperature, mixed air temperature, outside air temperature, OA damper differential pressure and the supply fan status/VFD speed. Trending shall occur during the season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO2 sensor using a known concentration of CO2 test gas to verify sensor reading. Also, test CO2 override when levels rise above setpoint. When CO2 setpoint is exceeded the unit shall provide additional ventilation to lower CO2 levels. Functional test sequence for maintaining minimum outside air ventilation. Functional test physical/logical duct static safeties.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	29
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	S-7 minimum outside air ventilation is higher than required.	Date Identified:	2/8/2012
Description of Finding:	Trending indicates the minimum outside air setpoint/damper introduces more outside air to the spaces than required. Based the trends the minimum ventilation was found to be 22% of max supply.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Controls and Balancing Contractors	Benefits:	Energy savings due to reduced outside air ventilation.
Baseline Documentation Method:	Trending of OAT, RAT, MAT and OA damper position.		
Measure:	Provide minimum outside air control based on CO2 levels and negative mixing box strategies.		
Recommendation for Implementation:	1. To set and maintain the minimum ventilation requires a balancer and a controls contractor. A negative pressure mixing box controls strategy shall be used to maintain minimum outside air. To do so requires installing a differential pressure sensor which measures the DP across the OA damper. Control of the RA and OA dampers to be independent requires separate analog outputs to each damper. Then with the AHU at max supply flow adjust the OA and RA damper positions in opposition until the minimum outside air volume is achieved. At this point the OA damper minimum position is determined/programmed. The DP across the OA, at minimum position, is now the setpoint for RA damper control. The RA damper shall modulate to maintain the balancer determined DP setpoint across the OA damper during all occupied modes of operation. This ensures that the required ventilation is maintained at all fan speeds. Based on current space use, square footage, and occupancy the initial minimum ventilation is 2920 CFM (adj.). Ensure all physical and logical duct static safeties (Low return static) are in place and functional. 2. Controls contractor to remove and replace existing CO2 sensor and provide programming for overriding minimum outside air ventilation based on building CO2 levels. When return air CO2 levels are below 500PPM + Ambient PPM the OA dampers to control for economizing. Upon CO2 detection above the calculated setpoint the unit increases OA intake to reduce CO2 levels in the return air. Verify occupant counts at the time of implementation and re-evaluate the appropriate minimum ventilation rates. 3. Replace/relocate building static sensor/reference. Change building static pressure setpoint to be 0.02". Utilize 0.04-0.07" deadband.		
Evidence of Implementation Method:	Trending of CO2 sensor and outside air damper, return air damper, return air temperature, mixed air temperature, outside air temperature, OA damper differential pressure and the supply fan status/VFD speed. Trending shall occur during the season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO2 sensor using a know concentration of CO2 test gas to verify sensor reading. Also, test CO2 override when levels rise above setpoint. When CO2 setpoint is exceeded the unit shall provide additional ventilation to lower CO2 levels. Functional test sequence for maintaining minimum outside air ventilation. Functional test physical/logical duct static safeties.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details



Building: Transportation Building

FWB Number:	14201	Eco Number:	30
Site:	Transportation Building	Date/Time Created:	5/2/2012

Investigation Finding:	S-8 minimum outside air ventilation is higher than required.	Date Identified:	2/8/2012
Description of Finding:	Trending indicates the minimum outside air setpoint/damper introduces more outside air to the spaces than required. Based the trends the minimum ventilation was found to be 14% of max supply.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Combined with Other Finding		

Implementer:	Controls and Balancing Contractors	Benefits:	Energy savings due to reduced outside air ventilation.
Baseline Documentation Method:	Trending of OAT, RAT, MAT and OA damper position.		
Measure:	Provide minimum outside air control based on CO2 levels and negative mixing box strategies.		
Recommendation for Implementation:	1. To set and maintain the minimum ventilation requires a balancer and a controls contractor. A negative pressure mixing box controls strategy shall be used to maintain minimum outside air. To do so requires installing a differential pressure sensor which measures the DP across the OA damper. Control of the RA and OA dampers to be independent requires separate analog outputs to each damper. Then with the AHU at max supply flow adjust the OA and RA damper positions in opposition until the minimum outside air volume is achieved. At this point the OA damper minimum position is determined/programmed. The DP across the OA, at minimum position, is now the setpoint for RA damper control. The RA damper shall modulate to maintain the balancer determined DP setpoint across the OA damper during all occupied modes of operation. This ensures that the required ventilation is maintained at all fan speeds. Based on current space use, square footage, and occupancy the initial minimum ventilation is 2920 CFM (adj.). Ensure all physical and logical duct static safeties (Low return static) are in place and functional. 2. Controls contractor to remove and replace existing CO2 sensor and provide programming for overriding minimum outside air ventilation based on building CO2 levels. When return air CO2 levels are below 500PPM + Ambient PPM the OA dampers to control for economizing. Upon CO2 detection above the calculated setpoint the unit increases OA intake to reduce CO2 levels in the return air. Verify occupant counts at the time of implementation and re-evaluate the appropriate minimum ventilation rates. 3. Replace/relocate building static sensor/reference. Change building static pressure setpoint to be 0.02". Utilize 0.04-0.07" deadband.		
Evidence of Implementation Method:	Trending of CO2 sensor and outside air damper, return air damper, return air temperature, mixed air temperature, outside air temperature, OA damper differential pressure, the supply fan status/VFD speed, space static pressure, and relief fan speed. Trending shall occur during the season for a minimum duration of 3 weeks. Trending interval to be 15 minutes or less. Functional testing of CO2 sensor using a known concentration of CO2 test gas to verify sensor reading. Also, test CO2 override when levels rise above setpoint. When CO2 setpoint is exceeded the unit shall provide additional ventilation to lower CO2 levels. Functional test sequence for maintaining minimum outside air ventilation. Functional test physical/logical duct static safeties.		

Estimated Annual Total Savings (\$):	\$0	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	0	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

The following is a list of measures that were investigated as part of our PBEEEP project at the Transportation Building but did not meet the criteria of PBEEEP program due to lengthy paybacks or too broad of assumptions rendering some measures unsubstantiated. These measures were not included in the final report delivered by MNCEE. Since this effort was conducted and paid for through the program, this information is still useful for the owner in making decisions moving forward despite the inability to make them part of the program.

1. **Control Heat Exchangers to Setpoint:** The domestic hot water heat exchanger is not controlled and maintains a supply temperature that is much higher than required. The average system temperature was 182°F during the heating season, 178°F during the shoulder season, and 175°F during the cooling season. The minimum temperature that must be maintained is determined by the temperature requirements of the dishwasher in the kitchen. The dishwasher has a booster heater which accepts supply water temperatures as low as 110°F. For this measure the new DHW setpoint for the kitchen is 120°F. A 120°F setpoint is used instead of 110°F to allow for any system degradation that will affect the booster heater capacity. A control valve can be added to the incoming district hot water side of the heat exchanger to regulate the flow and control the temperature of the buildings domestic hot water. This will also require a new temperature sensor on the domestic hot water output from the heat exchanger. By controlling the setpoint, the estimated district hot water savings is 23,201 kBtu, and an estimated cost avoidance of \$487 annually. The simple payback is 20.1 years.
2. **Replace SF-8 Return Air Humidity Sensor:** Trending indicates the return air humidity is 10.4% all year. Since the humidifier for this unit was never active, this measure does not have any savings associated with it at this time. However, if the humidifier is ever used in the future this sensor must be replaced.
3. **Replace Pneumatic VAV Controller:** This measure is considered a value engineered version of the PBEEEP approved DDC VAV upgrade measure (Finding #24). Despite the more attractive payback of this solution, its control limitations for occupancy control, future cubical/office layouts, setpoint and setback changes, and BAS troubleshooting/adjusting will not be available. Due to the inherent limitations of pneumatic VAV controls, the upgrade to DDC is recommended. However, replacing failing pneumatic controllers with new pneumatic controllers will result in reduced electrical and district energy usage. The estimated savings for replacement pneumatic VAV controllers are 345,840 kWh, 362,356 kBtu of chilled water, and 554,212 kBtu of hot water. The estimated cost avoidance is \$38,730 with a simple payback of 10.5 years.



414 Nicollet Mall, GO-6
Minneapolis, MN 55401

1-800-481-4700
xcelenergy.com

April 25, 2011

**MN Capitol Complex
Transportation Building
Attn: Gene Peterman
50 Sherburne Ave.
St. Paul, MN 55101**

Dear Gene:

Thank you for participating in Xcel Energy's Recommissioning program. We have reviewed your study application and proposal and have preapproved your study. The following outlines your rebate and project information:

Building Address	Transportation Building 395 John Ireland Blvd		
Study Cost	\$64,000.00	Study Number	RM1567
Preapproved study rebate*	\$25,000.00		
<small>* Your rebate was based on the study cost provided. If the final study cost is lower, your rebate will be adjusted accordingly.</small>			
Study Provider	Sebesta Blomberg & Associates		
Account manager	Barb Jerhoff	Phone 651-294-5565	

Here's a quick review of the Recommissioning program process:

- Once your study is complete, your study provider will send a draft copy to us for review.
- After we complete our review and approve the study, we will send you a confirmation letter noting our approval.
- Your study provider will schedule a wrap-up meeting with you and your Xcel Energy account manager to go over the results of the study.
- You pay the study provider for the full cost of the study.
- You submit the Recommissioning Study Rebate Application, along with a copy of the invoice and your Customer Implementation Plan, to us within 3 months of your report presentation. Please work with your account manager to complete the Customer Implementation Plan.
- We'll send your study rebate check to you.



414 Nicollet Mall, GO-6
Minneapolis, MN 55401

1-800-481-4700
xcelenergy.com

Please note that we need to approve the final study in order to receive your study rebate.

This study pre-approval is valid for **3 months** from the date of this letter. If your study will take longer than that, please let us know. If you have any questions or comments, please call your assigned Xcel Energy account manager. Thanks again for participating in our Recommissioning program.

Sincerely,

A handwritten signature in black ink, appearing to read 'Jon Packer'.

Jon Packer
Marketing Assistant, Recommissioning

Attachment

CC: Barb Jerhoff - Xcel Energy
Sherryl Volkert - Xcel Energy
James Miller - Sebesta Blomberg & Associates

PBEEEP

State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR DEPARTMENT OF TRANSPORTATION BUILDING



November 15, 2010

Summary Table

Department of Transportation Building	
Location	395 John Ireland Blvd, St. Paul, MN 55155
Facility Manager	Gene Peterman
Number of Buildings	1 (includes parking garage)
Interior Square Footage	374,818
PBEEEP Provider	Center for Energy and Environment (Angela Vreeland)
State's Project Manager	Pat Ferrin
Date Visited	November 10, 2010
Annual Energy Cost (from B3)	\$757,938 (2009)
Utility Company	District Energy St. Paul (Hot and Chilled Water), Xcel Energy (Natural Gas and Electricity)
Site Energy Use Index (from B3)	102.3 kBtu/ft ² (2009)
Benchmark EUI (from B3)	111.3 kBtu/ft ²

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of the Department of Transportation Building was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on November 10, 2010 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

The Department of Transportation Building is a 374,818 square foot (sqft) building located in St. Paul, MN. The building primarily consists of office space, but there is also a cafeteria (9,905 sqft), a computer center (4,289 sqft), and an underground parking garage (12,686 sqft). It has a tower on the Northern end of the building that is nine stories above grade (ground floor through eighth floor) and two stories below grade (basement and sub-basement). The Southern part of the building (approximately half the building footprint) has two stories above grade.

Recommendation for Investigation

An investigation of the energy usage and energy savings opportunities of the Department of Transportation Building and the below-grade garage is recommended.

Building Name	State ID	Square Footage	Year Built
Department of Transportation Building	G0231010562	374,818	1956

Mechanical Equipment

The building is conditioned by hot and chilled water from St. Paul District Energy. The hot water is available year-round and the chilled water is available from April 1st to November 1st each year. District hot water is brought into the sub-basement of the building where it is then run through heat exchangers. There is one heat exchanger that transfers the heat from the district hot water to glycol. The glycol is circulated to a make-up air unit and four of the air handlers. There are two other heat exchangers that transfer heat from the district hot water to hot water loops that serve two air handlers, VAV boxes, unit heaters, and finned-tube radiation. The district chilled water is also brought into the sub-basement, but there are no heat exchangers in the chilled water loop. The district chilled water is pumped directly to the air handlers to provide cooling.

There are two large air handlers (AHU 2 and 3) in the sub-basement that serve the basement through sixth floor of the tower portion of the building. The air handlers serve VAV boxes in the spaces. Two air handlers (S 7 and S 8) serve VAV boxes in floors seven and eight of the tower. There are four smaller air handlers (AHU 1, 4, 7, and 10) that serve the sub-basement, elevator equipment room, mail room, and the portion of the ground and first floors that are not part of the tower. There is also a make-up air unit that serves the garage.

The air handlers along with some other mechanical equipment were replaced in phases, beginning in 1991 and ending in 2001. The building originally had perimeter radiation, but almost all of it was removed during the phased equipment replacements. The only remaining hot water perimeter radiation is in the cafeteria along the exterior windows. The VAV boxes were not replaced during the air handler replacements and the age of the VAV boxes is unknown; however, there are reported to be plans to replace the VAV boxes when funding becomes available, but this has not been confirmed.

The two large air handlers, AHU 2 and 3, serve the North and South sides of the tower from the basement to the sixth floor. Since the time that these air handlers were installed in 1997, they have had problems reaching the duct static setpoint even when the VFDs are at 100% speed. A balancing report was done on the air handlers in 2000 and it confirmed that they were not able to achieve a high enough duct static to supply the VAV boxes with adequate supply air.

The following table lists the key mechanical equipment at the facility.

Controls and Trending

The building runs on a Honeywell EBI R310.1 Building Automation System (BAS), which is part of the State Capitol Complex system. The Plant Management Division (PMD) of the Department of Administration controls the BAS. PMD will set up all trending required for the project based on the direction of the recommissioning provider. The trend data is exported in a standard format such as csv. All equipment in the building is DDC, except for the majority of the VAV boxes, which have pneumatic actuation and control. The points on the automation system for the mechanical equipment are listed in the following Building Summary Table.

Lighting

The majority of the interior lighting is 32W T8 fixtures. Most spaces have motion detectors to control the lighting, but some spaces were switched to manual operation because the lights would turn off when people were working in the spaces.

The facility just recently had a lighting study performed which includes energy saving recommendations; this study will be a source of measures to be considered for implementation under PBEEEP.

Energy Use Index B3 Benchmark

The site Energy Use Index (EUI) for the building is 102.3 kBtu/sqft, which is 8% lower than the B3 Benchmark of 111.3 kBtu/sqft. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average.

Metering

The building has one electric meter, one natural gas meter, one chilled water meter, and one hot water meter. Natural gas is used only by the kitchen.

Documentation

Much of the mechanical equipment in the building was replaced in phases starting in 1991 and ending in 2001. All of the documentation from the equipment replacements is available in electronic CAD files. Balance reports are also available.

Mechanical Equipment Summary Table	
Quantity	Equipment Description
1	Honeywell EBI Automation System
1	Building
374,818	Interior Square Feet (before 1,200 sqft addition)
8	Air Handlers
~430	VAV Boxes
1	Make-up Air Unit
9	Computer Room Air Conditioning Units
1	Steam Boiler (electric)
8	Pumps (HW and CHW)
250	Approximate number of points for trending

This screening report is based on the PBEEEP Guidelines. It is based on one site visit, review of the facility documentation, building automation system, a limited inspection of the facility and interviews with the staff. The purpose of the screening report is to evaluate the potential of the facility for the implementation of cost-effective energy efficiency savings through recommissioning. To the best of our knowledge the information here is accurate. It provides a high level view of many of the important parameters of the mechanical equipment in the facility. Because it is the result of a limited audit survey of the facility, it may not be completely accurate or inclusive.

Reasons for Recommendation

There are many factors that are part of the decision to recommend an energy investigation of a building. Some characteristics at the Transportation Building that were taken into account during the building selection process were:

- Potential energy savings opportunities observed during screening phase
- Large square footage
- Level of control by the building automation system
- Equipment size and quantity
- Frequency and severity of comfort and/or control issues
- Support from the staff and management to include building in an investigation

One key factor with the Transportation Building is that there are known operational issues that could be resolved with further investigation. Air handlers AHU 2 and 3 are not able to meet the duct static pressure setpoint and the return hot water temperature occasionally goes above the temperature required by District Energy St. Paul, leading to additional utility fees. It is possible that these issues could be resolved with recommissioning and other energy reduction opportunities identified.

Another reason for recommending this building for investigation is that the Energy Use Index (EUI) for the site is 8% lower than the B3 Benchmark EUI. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average, which would indicate that the Transportation Building can reduce its energy use. Based on the screening process, the facility appears to have potential for further EUI reduction and energy savings from an investigation.

Building Summary Table

The following tables are based on information gathered from interviews with facility staff, a building walk-through, automation system screen-captures, and equipment documentation. The purpose of the tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge.

Department of Transportation Building State ID# G0231010562					
Area (sqft)	374,818	Year Built	1956	Occupancy (hrs/yr)	4,368
HVAC Equipment					

Air Handlers (8 Total)

Description	Type	Size	Notes
AHU 1	VAV with VFDs on SF and RF	29,000 cfm 40 hp SF 20 hp RF	CHW and glycol heating, serves VAV boxes in the ground and first floors (not part of the tower).
AHU 2	VAV with VFDs on SFs and RF	110,000 cfm 75 hp SFs each 50 hp RF 5 hp OA Fan	CHW and glycol heating, serves VAV boxes in basement through 6 th floor of tower.
AHU 3	VAV with VFDs on SFs and RF	110,000 cfm 75 hp SFs each 50 hp RF 5 hp OA Fan	CHW and glycol heating, serves VAV boxes in basement through 6 th floor of tower.
AHU 4	Constant Volume with SF and RF	8,400 cfm, 1.5 hp SF	Glycol heating, serves sub-basement.
AHU 7	Constant Volume with SF	2,000 cfm	CHW, serves Mail Room. <i>This equipment is not on the BAS.</i>
AHU 10	Constant Volume with SF and Transfer Fan (TF)	4,500 cfm, 3 hp SF 1/6 hp TF	CHW, serves elevator equipment room.
Fan S 7	VAV with VFDs on SF and RF	33,700 cfm 40 hp SF 10 hp RF	CHW and HW, serves VAV boxes in 7 th floor.
Fan S 8	VAV with VFDs on SF and RF	40,500 cfm 50 hp SF 15 hp RF	CHW and HW, serves VAV boxes in 8 th floor.

Make-up Air Unit

Description	Type	Size	Notes
MAU 1	VAV with VFD on SF	15,000 cfm 7 hp	HW, serves Garage

VAV Boxes (78 Total)

Description	Type	Size	Notes
VAV boxes			HW reheat, reheat is not used during the summer.

Fan Coil Unit

Description	Type	Size	Notes
FC 11			HW, serves John Ireland entry.

HVAC Equipment Cont'd

Unit Heaters (2 Total)

Description	Type	Size	Notes
UH 1 UH 2		600 cfm ea	HW, serve Garage and Outdoor Storage. <i>This equipment is not on the BAS.</i>

Exhaust Fans (9 Total)

Description	Type	Size	Notes
EA 1		Less than 1 hp	
EA 3		3,150 cfm, 1.5 hp	Serves basement.
EF 5		12,600 cfm, 2 hp	Serves electrical equipment room B42. <i>This equipment is not on the BAS.</i>
EF 6		13,550 cfm, 10 hp	Serves kitchen hoods. <i>This equipment is not on the BAS.</i>
EA 11		Less than 1 hp	
EA 12		Less than 1 hp	
EA 16		13,550 cfm, 10 hp	
EF 35		Less than 1 hp	
EF 36		Less than 1 hp	

Computer Room Air Conditioning Units (9 Total)

Description	Type	Size	Notes
CRCU 1 CRCU 2 CRCU 3		2,400 cfm ea, 4.33 tons ea	Serve rooms B41 and B38.
CRCU 4 CRCU 5 CRCU 6		5,200 cfm ea, 6.33 tons ea	Serve room B39.
CRCU 7 CRCU 8 CRCU 9		17.5 tons total	Serve Network Operations. <i>This equipment is not on the BAS.</i>

Chilled Water System

Description	Type	Size	Notes
2 CHWPs	Variable Volume CHWPs	7.5 hp ea	
P 14a P 14b	Variable Volume CHWPs	1,360 gpm ea, 30 hp ea	In parallel, circulate CHW to AHUs

Hot Water System

Description	Type	Size	Notes
Heat Exchanger	HW to HW Heat Exchanger		Heat exchanger for between District HW and building preheat HW
P 1 P 2 P 3	Variable Volume HWP	235 gpm ea, 7.5 hp ea	In parallel, circulate HW
P 4	Variable Volume Glycol Pump	7.5 hp	Circulates glycol

HVAC Equipment Cont'd

Boiler

Description	Type	Size	Notes
B 1	Electric Steam Boiler	1,255 pph out, 420 kW in	Provides humidification to S 7 and S 8. <i>This equipment is not on the BAS.</i>

Kitchen Coolers (3 Total: Units 21, 22, 24)

Kitchen Freezer (1 Total: Unit 23)

Points on BAS

Air Handlers

Description	Points
AHU 1	RARH, RARH setpoint, RA CO2 ppm, RF VFD speed, RAT, Econ damper position, MAT, MAT setpoint, Heating valve, Cooling valve, SF status, SF VFD speed, DA DSP, DA DSP setpoint, DAT, DAT setpoint, DARH, DARH setpoint, Economizer on/off, Economizer OAT lockout, DA reset temps
AHU 2 AHU 3	RA DSP, RA DSP setpoint, RF VFD speed, RARH, RARH setpoint, RAT, Relief static pressure, Relief static pressure setpoint, Econ damper position, OA Fan status, MAT, MAT setpoint, Heating valve, Cooling valve, SF status, SF VFD speed, DAT, DAT setpoint, Economizer on/off, Economizer OAT lockout, DA reset temps
AHU 4	Econ damper position, MAT, MAT setpoint, Heating valve, SF status, DAT, Economizer on/off, Economizer OAT lockout, Room temp, Room temp setpoint
AHU 10	RAT, RARH, Econ damper position, MAT, MAT setpoint, Cooling valve, SF status, DAT, DAT setpoint, Economizer on/off, Economizer OAT lockout, DA reset temps, Room temp
Fan S 7 Fan S 8	RARH, RARH setpoint, RA DSP, RA DSP setpoint, RAT, Relief fan status, Relief fan VFD speed, Econ damper position, Econ damper position setpoint, MAT, MAT setpoint, Heating valve, Cooling valve, SF status, SF VFD speed, DA DSP, DA DSP setpoint, DAT, DAT setpoint, Economizer on/off, Economizer OAT lockout, Room temp, Room static pressure, Room static pressure setpoint, DA reset temps

Make-up Air Unit

Description	Points
MAU 1	Heating valve, Fan status, Fan VFD speed, DAT, DAT setpoint, Space CO ppm

VAV Boxes

Description	Points
Each Unit	Max CFM, Actual CFM, Min CFM, Damper position, HW reheat valve, Heating setpoint, Room temp, Cooling setpoint

Fan Coil Unit

Description	Points
Each Unit	RAT, Fan status, Heating valve, DAT, DAT reset temps, Occ/Unocc status

Exhaust Fans

Description	Points
Each Unit	EF status

Chilled Water System

Description	Points
System	CHWST, Pump status, Pump VFD speed, AHU CHWS valve, CHW DP, CHW DP setpoint, CHWR GPM, CHWRT, CHWRT setpoint, CHWR valve, CHWR valve setpoint, OAT valve enable setpoint, OAT pump enable setpoint

Points on BAS Cont'd

Hot Water System

Description	Points
System	Building HWRT, Building HWST, Building HWST setpoint, HWP status, HWP VFD speed, District HWR valve, OA reset points

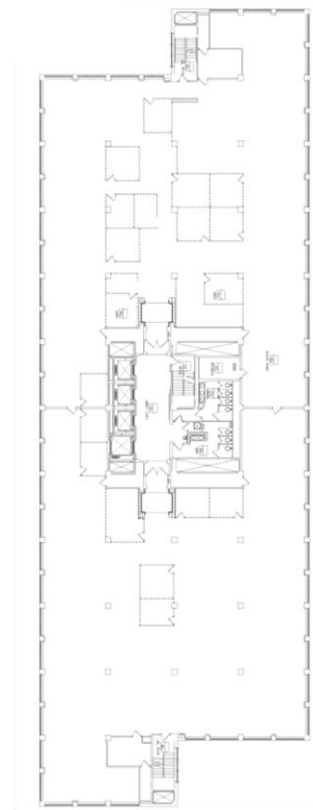
Lighting

Description	Points
John Ireland Canopy	On/off
Lot G and F	On/off

Building Floor Plans



First Floor



Seventh Floor

PBEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HP	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CV	Constant Volume	MAT	Mixed Air Temperature
DA	Discharge Air	MAU	Make-up Air Unit
DA Enth	Discharge Air Enthalpy	OA	Outside Air
DARH	Discharge Air Relative Humidity	OA Enth	Outside Air Enthalpy
DAT	Discharge Air Temperature	OARH	Outside Air Relative Humidity
DDC	Direct Digital Control	OAT	Outside Air Temperature
DP	Differential Pressure	Occ	Occupied
DSP	Duct Static Pressure	PTAC	Packaged Terminal Air Conditioner
DX	Direct Expansion	RA	Return Air
EA	Exhaust Air	RA Enth	Return Air Enthalpy
EAT	Exhaust Air Temperature	RARH	Return Air Relative Humidity
Econ	Economizer	RAT	Return Air Temperature
EF	Exhaust Fan	RF	Return Fan
Enth	Enthalpy	RH	Relative Humidity
ERU	Energy Recovery Unit	RTU	Rooftop Unit
FCU	Fan Coil Unit	SF	Supply Fan
FPVAV	Fan Powered VAV	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH